

4.0 STANDARDS FOR THE INSTALLATION OF GRAVESITES

4.0.1 Orientation for Gravesite Inspectors

This section provides VAC gravesite inspectors with a set of standards by which to determine the successful completion for installations of veterans' grave markers. The standards cover all aspects of the gravesites, including grave markers, their inscriptions, foundations and mounting, as well as grave surfacing, to which cemetery staff or private contractors must comply.

Whenever gravesite inspectors are assessing new installations, including replacement grave markers, this will be the most important section in the *National Technical Maintenance Manual for Veterans' Gravesites in Canada*, to determine whether to accept the new work of the contractor.

The following standards represent a process of evolution. The master policy document for the installation of veterans' gravesites is VAC's *Veterans Programs Policy Manual* [VPPM], and specifically Volume IV, Commemorative Programs, Appendices E and F, dated September 1997. The specifications from this document have since been updated by the LPF in their *Management and Operations Manual* [LPFMOM], Section 4.8.3 Grave (Memorial) Marker Specifications, dated January 22, 2002. This set of standards has in turn been analyzed by the current project team, and changes recommended in order to better control the standardization and longevity of the end products: veterans' grave markers, inscriptions, foundations, connections, and grave surfacing.

It should be noted that VAC is also responsible for supplying grave markers for service personnel of the Department of National Defence [DND] and for Civilians, i.e. First Aid workers, who have made contributions to Canada's war efforts. In addition to the standards for veterans' markers, this section will also include standards for Civilian and DND grave markers.

For the benefit of VAC and LPF staff, it should be noted that a number of changes have been made to previous marker specifications, particularly in the subsection on inscriptions, in order to correct errors or omissions. Some of these changes include:

- specifying 6mm (¼") minimum depth for all inscriptions in order to ensure legibility;
- specifying 25mm (1") minimum height for all inscribed letters in order to ensure that the minimum depth of inscription can be achieved from the sand blast process;
- changing the maximum number of letter spaces on lines of inscription to accommodate the changed letter sizes;
- adjusting the sizes of flat, pillow and bronze markers to accommodate the increased amount of inscription text called for in LPFMOM; and
- changing letter sizes on bronze markers to accommodate the increased amount of inscription text.

Note: Cemetery bylaws may stipulate that flat markers must be a certain size. In this situation, the inspector should discuss with the cemetery authority the possibility of accepting the standards in this manual when starting a new row.

4.0.2 Replacement of Veteran Grave Markers

There are two types of veteran grave markers:

Standardized veteran grave markers - are the markers described in this section and were placed at the expense of Canada.

Non-standardized veteran grave markers - are located mostly in departmentally owned cemeteries and in South Africa. They are usually historic military style markers which pre date the First World War and in some cases Confederation (1867). Non-standardize markers may or may not have been placed at the expense of Canada, yet are the responsibility of Canada.

When replacing veteran grave markers that are the responsibility of Canada:

- replace the standardized markers with markers that replicate the originals in conjunction with the grave marker specifications identified in this section.
- replace non-standardized markers with markers that replicate as closely as possible, the original. Replacement is a last resort and should only be considered in situations where corrective conservation efforts will not save the grave marker.

The policy is to be applied worldwide.

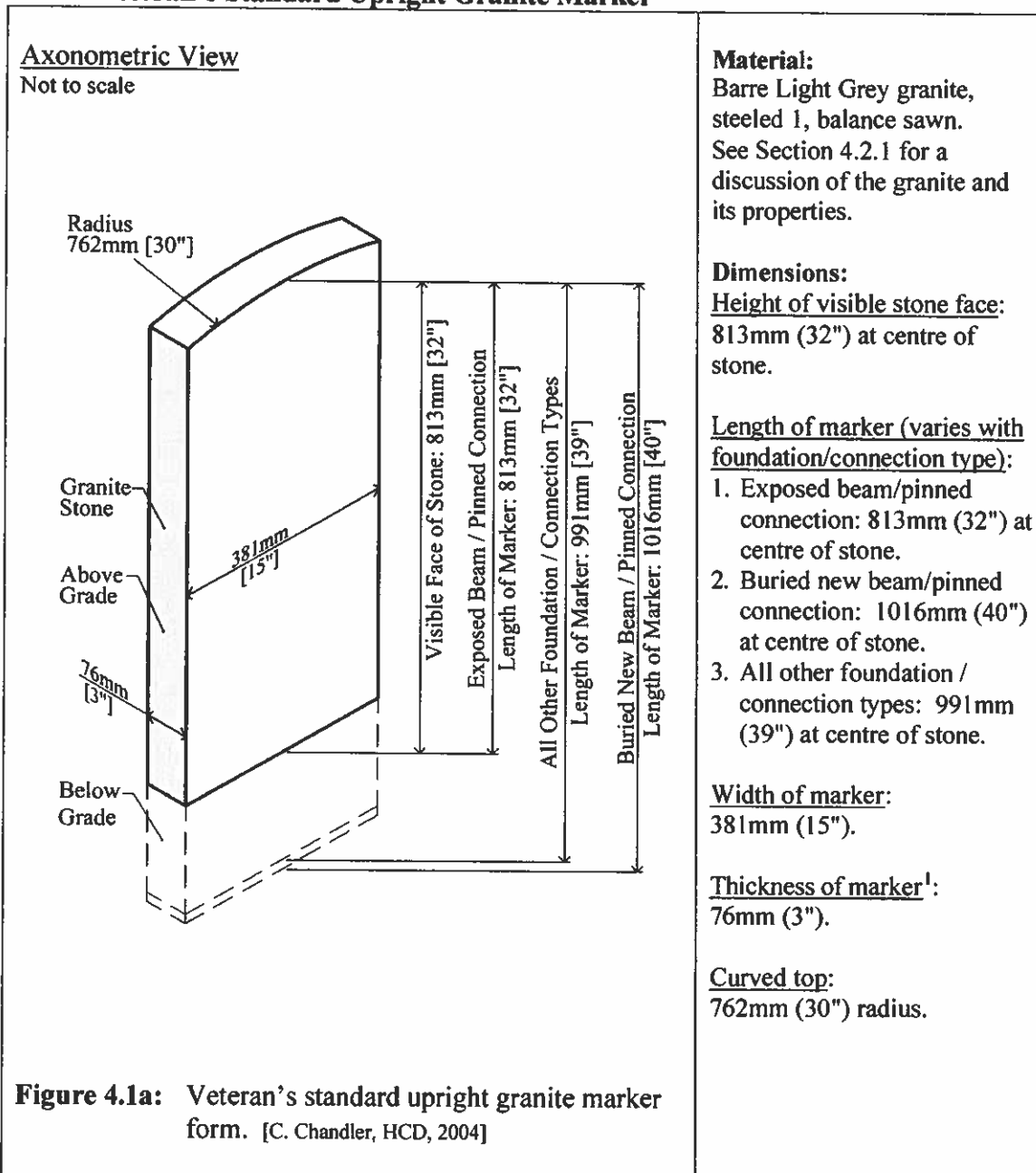
When replacing a Victoria Cross grave marker the inscription order is as follows:

- Top - maple leaf, official military crest or religious symbol;
- 1st line - Name;
- 2nd line - Rank;
- 3rd line - Unit and Conflict if space permits;
- 4th line - Date of Death;
- 5th line - Age;
- 6th line - Victoria Cross template; and
- Bottom - A few words/quote selected by family or regiment if space permits.

When replacing a marker that has a Maple Leaf on it, replace it with the copyrighted Commonwealth War Graves Commission Maple Leaf.

4.1 Markers: Form and Size

4.1.1 Veteran's Standard Upright Granite Marker



¹ Due to cemetery regulations in the Province of Ontario, the thickness of an upright marker in Ontario can be increased to 200mm (8").

4.1.2 Veteran's Standard Flat Granite Marker

Axonometric View

Not to scale

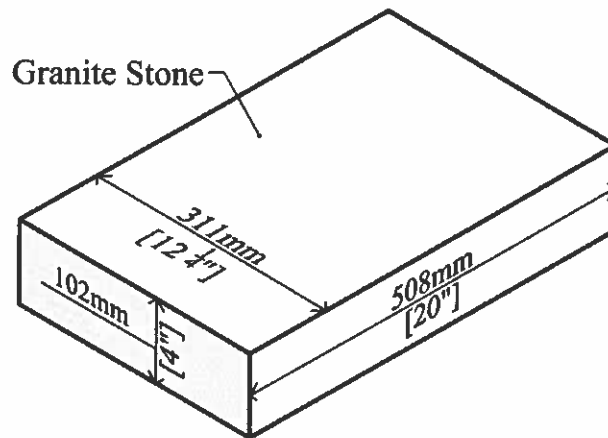


Figure 4.1b: Veteran's standard flat granite marker form. [C. Chandler, HCD, 2004]

Material:

Barre Light Grey granite, steeled 1, balance sawn.

See Section 4.2.1 for a discussion of the granite and its properties.

Dimensions:

508 x 311 x 102mm
(20" x 12 1/4" x 4")

4.1.3 Veteran's Special Order Pillow Granite Marker

Axonometric View

Not to scale

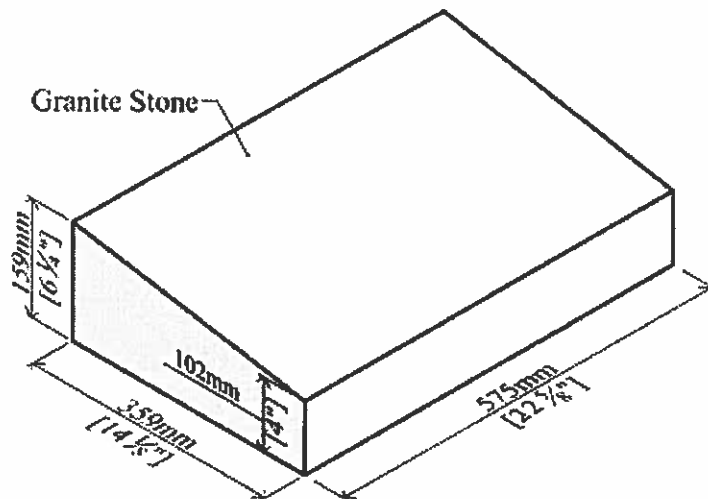


Figure 4.1c: Veteran's special order pillow granite marker form. [C. Chandler, HCD, 2004]

Material:

Barre Light Grey granite, steeled 1, balance sawn.

See Section 4.2.1 for a discussion of the granite and its properties.

Dimensions:

Length:

575mm (22 5/8").

Width:

359mm (14 1/8").

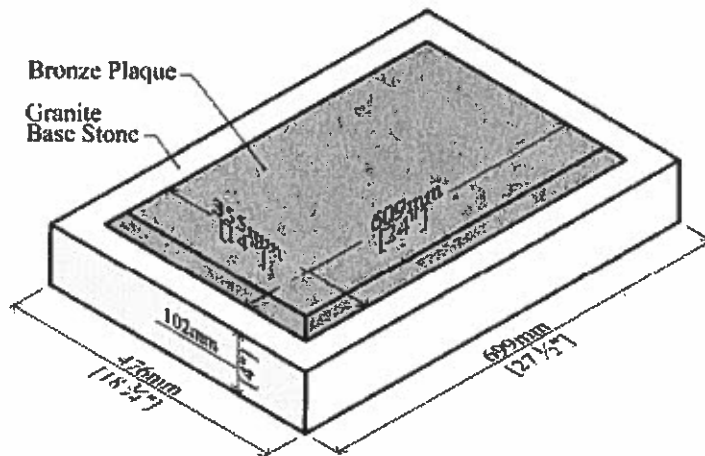
Thickness:

159mm sloping to 102mm
(6 3/4" sloping to 4").

4.1.4 Veteran's Special Order Flat Bronze Marker

Axonometric View

Not to scale



Material:

Bronze plaque mounted on Barre Light Grey granite, steeled 1, balance sawn.

See Section 4.2.2 for a discussion of the bronze, its properties, and its casting.

Dimensions:

Plaque:

609 x 355mm (24\" x 14\").
Bevelled edge only;
width of bevelled edge: 19mm (3/4\").

Stone Base:

699 x 476 x 102mm (27 1/2\" x 18 3/4\" x 4\").

Attachment:

Each memorial shall be cast with integral bosses on the back. These bosses shall be drilled and tapped to receive 1cm (0.39\") diameter anchor lugs of brass or bronze from 10 to 15cm (4\" to 6\") in length. These anchor lugs will be supplied with the memorial.

Figure 4.1d: Veteran's special order flat bronze marker form. [C. Chandler, HCD, 2004]

4.1.5 VAC Civilian Upright Granite Marker

Axonometric View

Not to scale

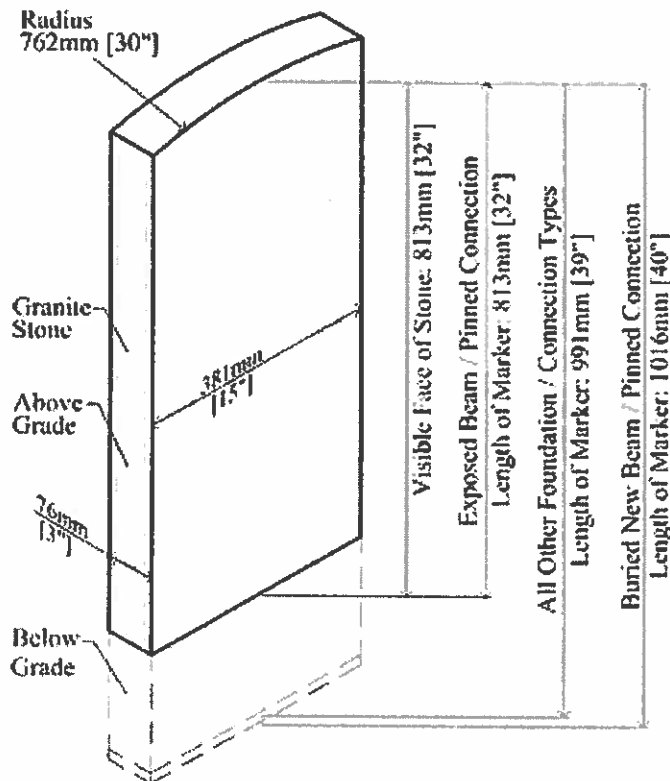


Figure 4.1e: VAC civilian upright granite marker form.
[C. Chandler, HCD, 2004]

Material:

Barre Light Grey granite, steeled 1, balance sawn. See Section 4.2.1 for a discussion of the granite and its properties.

Dimensions:

Height of visible stone face:
813mm (32") at centre of marker.

Length of marker (varies with foundation/connection type):

1. Exposed beam/pinned connection: 813mm (32") at centre of stone.
2. Buried new beam/pinned connection; 1016mm (40") at centre of stone.
3. All other foundation / connection types: 991mm (39") at centre of stone.

Width of marker:
381mm (15").

Thickness of marker²:
76mm (3").

Curved top:
762mm (30") radius.

²Due to cemetery regulations in the Province of Ontario, the thickness of an upright marker in Ontario can be increased to 200mm (8").

4.1.6 VAC Civilian Flat Granite Marker

Axonometric View

Not to scale

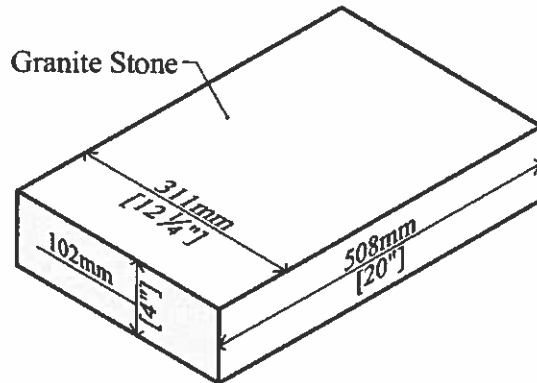


Figure 4.1f: VAC civilian flat granite marker form. [C. Chandler, HCD, 2004]

Material:

Barre Light Grey granite, steeled 1, balance sawn.

See Section 4.2.1 for a discussion of the granite and its properties.

Dimensions:

508 x 311 x 102mm
(20" x 12 1/4" x 4").

4.1.7 VAC Civilian Flat Bronze Marker

Axonometric View

Not to scale

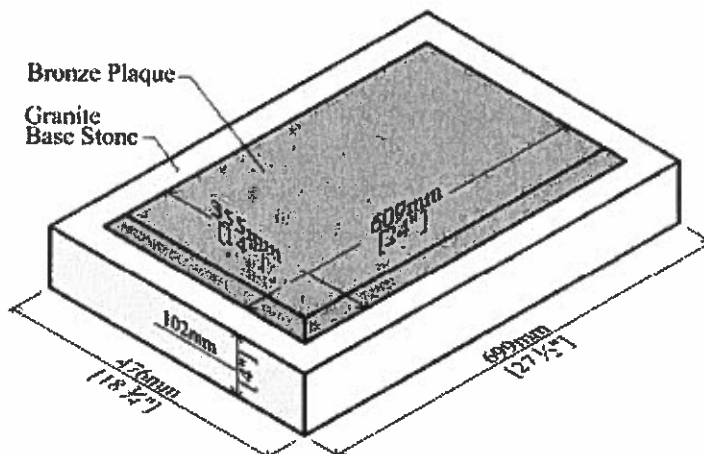


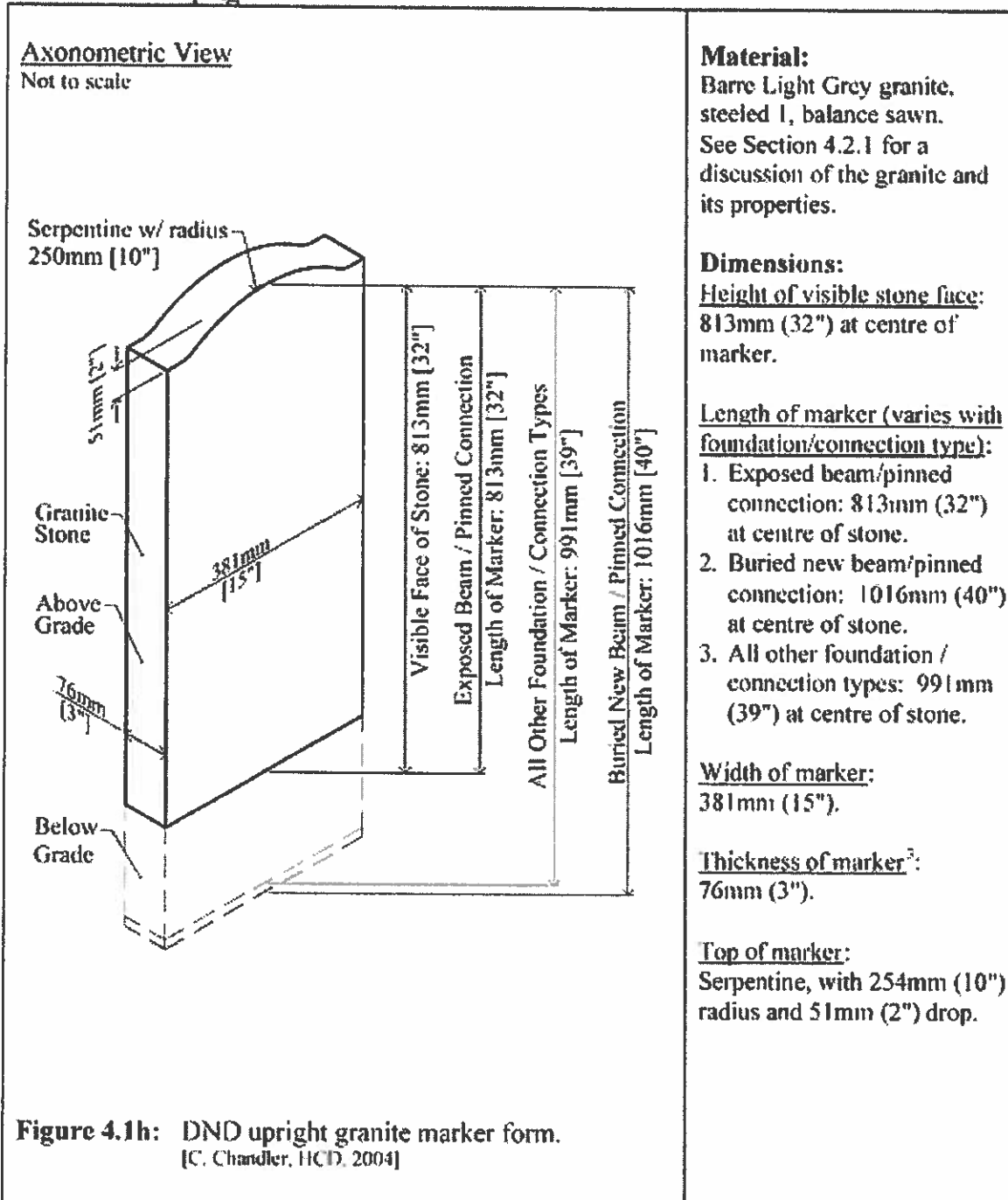
Figure 4.1g: VAC civilian flat bronze marker form. [C. Chandler, HCD, 2004]

Material: Bronze plaque mounted on Barre Light Grey granite, steeled 1, balance sawn. See Section 4.2.2 for discussion of bronze, its properties, and casting.

Dimensions: Plaque: 609 x 355mm (24" x 14"). Bevelled edge only; width of bevelled edge: 20mm (3/4"). Stone Base: 699 x 476 x 102mm (27 1/2" x 18 3/4" x 4").

Attachment: Memorial cast with integral bosses on back. Bosses drilled and tapped to receive 10mm (0.39") diameter anchor lugs of brass or bronze, from 102-152mm (4"- 6") in length. Anchor lugs supplied with the memorial.

4.1.8 DND Upright Granite Marker



Due to cemetery regulations in the Province of Ontario, the thickness of an upright marker in Ontario can be increased to 200mm (8").

4.1.9 DND Flat Granite Marker

Axonometric View

Not to scale

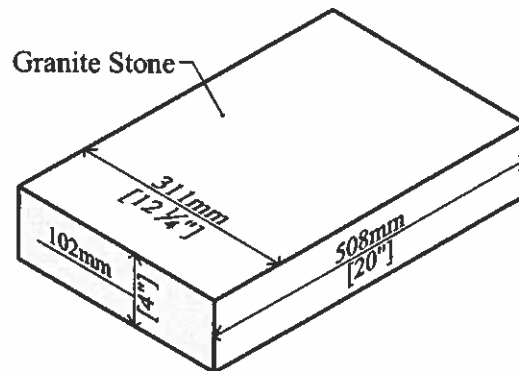


Figure 4.1i: DND flat granite marker form.
[C. Chandler, HCD, 2004]

Material:

Barre Light Grey granite, steeled 1, balance sawn. See Section 4.2.1 for a discussion of the granite and its properties.

Dimensions:

508 x 311 x 102mm
(20" x 12 1/4" x 4").

4.1.10 DND Flat Bronze Marker

Axonometric View

Not to scale

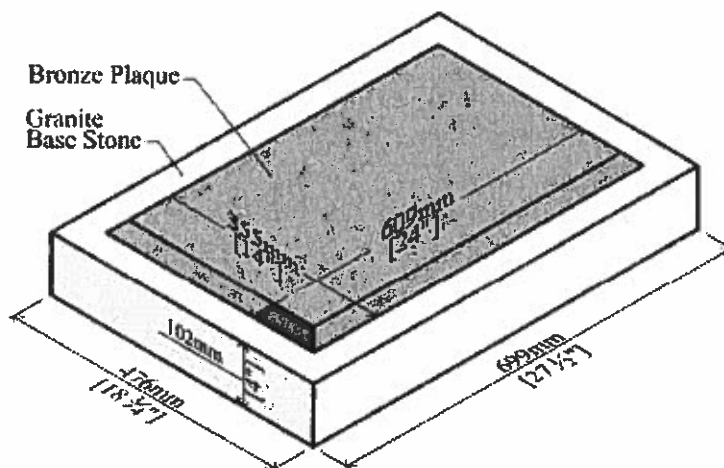


Figure 4.1j: DND flat bronze marker form.
[C. Chandler, HCD, 2004]

Material: Bronze plaque mounted on Barre Light Grey granite, steeled 1, balance sawn. See Section 4.2.2 for discussion of bronze, its properties, and casting.

Dimensions: Plaque:

609 x 355mm (24" x 14").

Bevelled edge only;

bevelled edge: 20mm (3/4").

Stone Base: 699 x 476 x

102mm (27 1/2" x 18 3/4" x 4").

Attachment: Each memorial cast with integral bosses on back. Bosses drilled and tapped to receive 10mm (0.39") diameter anchor lugs of brass or bronze, from 102-152mm (4"- 6") in length. Anchor lugs supplied with the memorial.

4.1.11 Cremation Markers

VAC has no standard form for markers indicating the interment of cremated remains. Typically cremated remains are interred either in the ground or above ground in columbaria. For veteran, VAC civilian and DND interments, grave markers for cremated remains should follow cemetery specifications as set out by cemetery authorities.

4.1.12 General Guidelines for Other Forms

Because of VAC's willingness to accommodate local cemeteries when the forms of the standard or special order LPF or VAC grave markers are not acceptable to a cemetery, a number of other forms have been used occasionally within Canada for veterans' graves. A number of these other marker forms fabricated from granite and occasionally from concrete, were observed during the site visits for this manual. The marker forms that were observed include: wedge-shaped markers, and scroll-shaped markers.

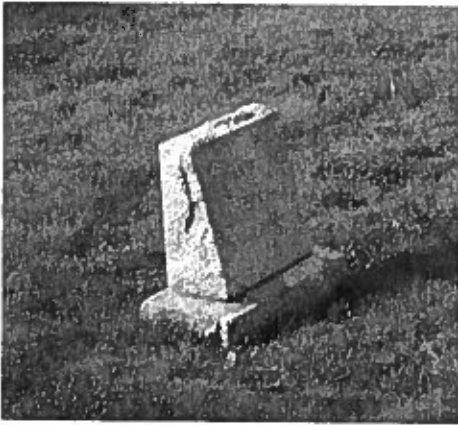


Figure 4.1k: Wedge-shaped marker.
[D. Stephenson, HCD, 2003]



Figure 4.1l: Scroll-shaped marker.
[D. Stephenson, HCD, 2003]

Because the current researchers visited only a small fraction of the cemeteries that contain veterans' graves, it is highly likely that there are additional 'other' marker forms in place at veterans' graves within Canada. It is impossible to provide standards for all the other forms that exist. However, it is recommended that when grave site inspectors encounter markers other than the standard and special order forms, they approach pertinent cemetery administrators to request specifications for these unusual markers in use. In this way a collection of fabrication standards for other forms of veterans' grave markers can be built up and added to this technical maintenance manual, if appropriate.

4.2 Markers: Materials and Alignment

4.2.1 Granite and Its Properties

The standard granite type for new VAC grave markers is listed in the LPFMOM as Barre Light Grey. Barre Light Grey granite is the VAC and LPF name for Barre Gray granite that is supplied under a registered trademark by Rock of Ages Corporation, P.O. Box 482, Barre Vermont 05641, USA.

The mechanical properties of Barre Gray, obtained from Rock of Ages, are noted in the table below.

| Table 4.2a Mechanical Properties for Barre Gray Granite | | |
|--|----------------------------|-------------------------|
| ASTM Test | Mechanical property | Average |
| ASTM C97-96 <i>Absorption and Bulk Specific Gravity</i> | Absorption | .206% |
| | Bulk Specific Gravity | 166 lbs/ft ³ |
| ASTM C99-87 <i>Modulus of Rupture</i> | Perpendicular dry | 2909 psi |
| | Perpendicular wet | 2621 psi |
| | Parallel dry | 2142 psi |
| | Parallel wet | 1900 psi |
| ASTM C170-90 <i>Compressive Strength</i> | Perpendicular dry | 29388 psi |
| | Perpendicular wet | 25000 psi |
| | Parallel dry | 23899 psi |
| | Parallel wet | 16293 psi |
| ASTM C880-98 <i>Flexural Strength</i> | Perpendicular dry | 2769 psi |
| | Perpendicular wet | 2437 psi |
| | Parallel dry | 1917 psi |
| | Parallel wet | 1567 psi |

4.2.2 Bronze, Its Properties and Casting

The cemetery bronze alloy shall consist of :

Copper.....82-87%

Tin.....3-7%

Lead..... 2% maximum

Zinc..... 3-8%

Each casting shall be true, free from all weakening defects of any character, and also free from minor defects and imperfections that would be visible from a distance of 90 cm (3 feet). All exposed surfaces must be smooth. No sand-like roughness will be permitted. All letters, numerals, ornamentation and insignia shall be finely buffed and highlighted.

Backgrounds shall be of sculptured texture and shall be finished in medium dark statuary bronze colour (brown) secured by chemical means through the formation of cupreous oxide and cupric oxide on the background surface. No sulphide finishes or painted or pigmented lacquer finishes will be permitted.

4.2.3 Marker Alignment

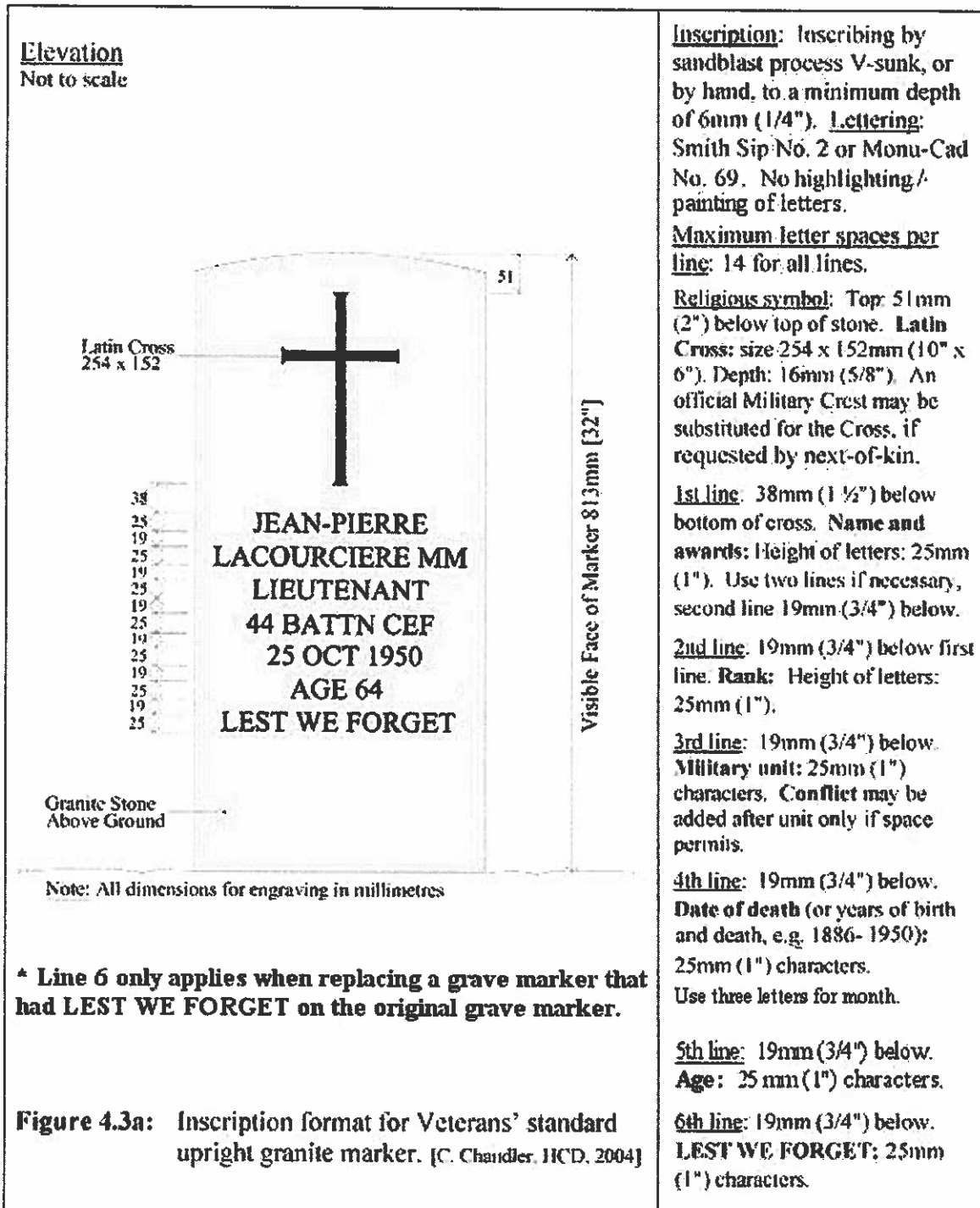
Marker alignment refers to the relationship between individual grave markers within a grouping of markers. It is suggested that VAC follow an adaptation of the criteria developed by the CWGC in the matter of alignment. During installation every effort should be made to ensure that all markers are plumb. Upright markers should show the standard 81.3 cm (32") height of face above ground level for buried foundations, and the same height above their foundations for exposed foundations. However, the criterion for acceptance *"is that the group of markers should conform reasonably with each other, and that seen from the face or the three-quarter face, they should not appear unsightly to the practiced eye"*. (CWGC, 1999, para. 945)



Figure 4.2a: An example of a well aligned group of upright markers. [D. Stephenson, HCD, 2003]

4.3 Inscriptions: Lettering Properties and Content

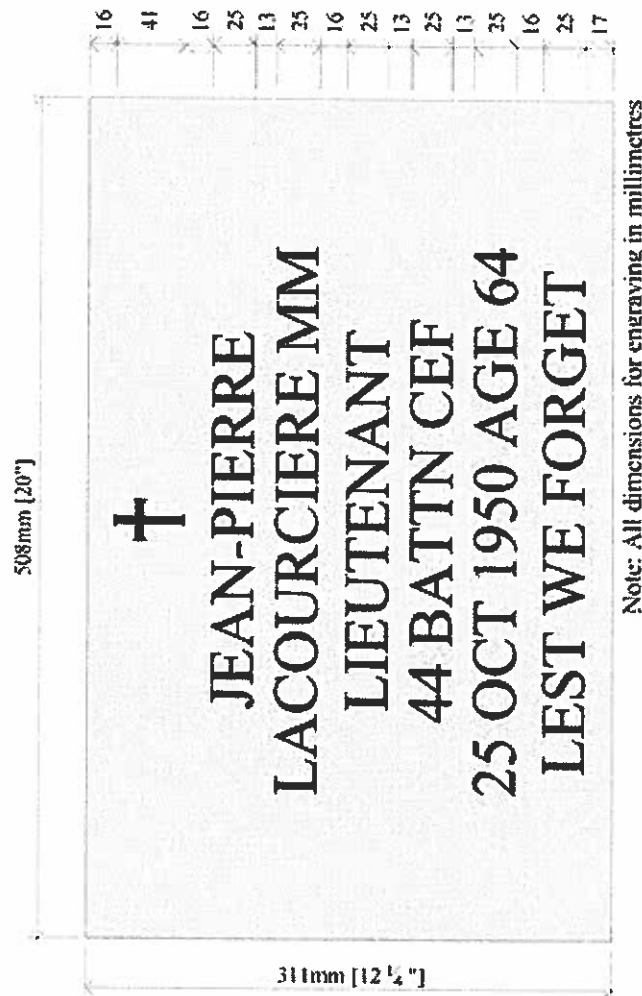
4.3.1 Inscription Format for Veterans' Standard Upright Markers



4.3.2 Inscription Format for Veterans' Standard Flat Granite Marker

Plan View

Not to scale



Note: All dimensions for engraving in millimetres

* Line 5 only applies when replacing a grave marker that had LEST WE FORGET on the original grave marker.

Figure 4.3b: Inscription format for Veterans' standard flat granite marker. [C. Chandler, HCD, 2004]

Inscription: Inscribing by sandblast process V-sunk, or by hand, to a minimum depth of 6mm (1/4"). **Lettering:** Smith Sip No. 2 or Monu-Cad No. 69.

No highlighting of letters.

Maximum letter spaces per line: 18 for all lines.

Religious symbol: Top: 16mm (5/8") below top of marker.
Latin Cross: size 41 x 25mm (1-5/8" x 1"). Depth: 10mm (3/8"). An official Military Crest may be substituted for the Cross, if requested by next-of-kin.

1st line: 16mm (5/8") below bottom of cross. **Name and awards:** Height of letters: 25mm (1"). Use two lines if necessary; second line 13mm (1/2") below.

2nd line: 16mm (5/8") below. **Rank:** Height of letters: 25mm (1").

3rd line: 13mm (1/2") below. **Unit or service:** Height of letters: 25mm (1").

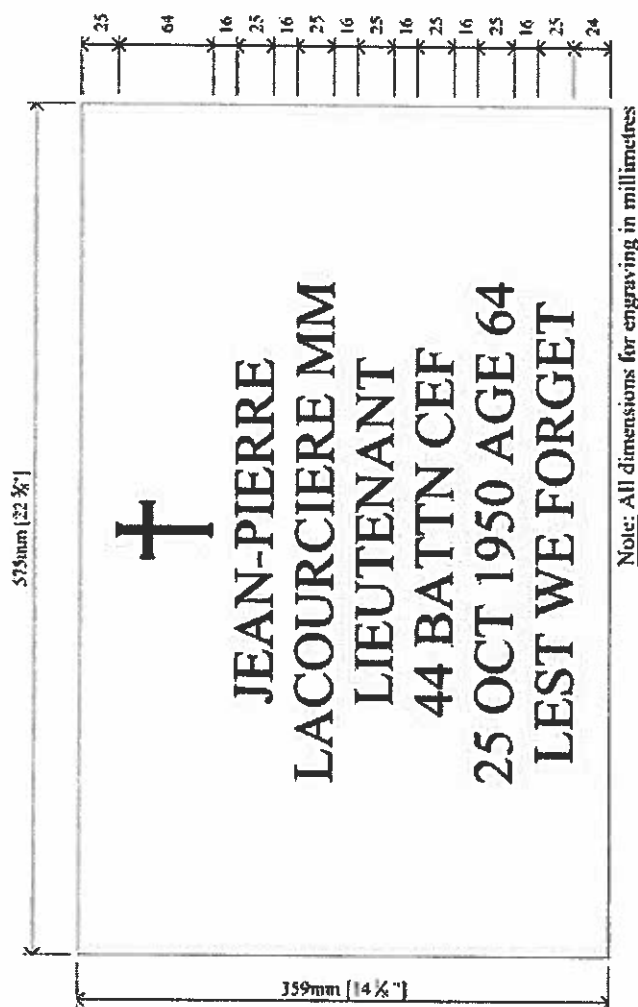
4th line: 13mm (1/2") below. **Date of death and age (or years of birth and death, e.g. 1886-1950):** Height of letters: 25mm (1"). Use three letters for month.

5th line: 16mm (5/8") below. **LEST WE FORGET:** Height of letters: 25mm (1").

4.3.3 Inscription Format for Veterans' Special Order Pillow Marker

Plan View

Not to scale



* Line 5 only applies when replacing a grave marker that had LEST WE FORGET on the original grave marker.

Figure 4.3c: Inscription format for Veterans special order pillow granite marker. [C. Chandler, HCD, 2004]

Inscription: Inscribing by sandblast process V-sunk, or by hand, to a minimum depth of 6mm (1/4"). **Lettering:** Smith Sip No. 2 or Monu-Cad No. 69.

No highlighting of letters.

Maximum letter spaces per line: 20 for all lines.

Religious symbol: Top: 25mm (1") below top of marker.

Latin Cross: size 64 x 38mm (2-1/2" x 1-1/2"). Depth: 10mm (3/8").

1st line: 16mm (5/8") below bottom of cross. **Name and awards:** Height of letters: 25mm (1"). Use two lines if necessary; second line 16mm (5/8") below.

2nd line: 16mm (5/8") below. **Rank:** Height of letters: 25mm (1").

3rd line: 16mm (5/8") below. **Unit or service:** Height of letters: 25mm (1").

4th line: 16mm (5/8") below. **Date of death and age (or years of birth and death):** Height of letters: 25mm (1"). Use three letters for month.

5th line: 16mm (5/8") below. **LEST WE FORGET:** Height of letters: 25mm (1").

4.3.4 Inscription Format for Veterans' Special Order Flat Bronze Markers

| | |
|---|--|
| <p>Plan View Not to scale</p> <p>Note: All dimensions for engraving in millimetres</p> <p>* Line 5 only applies when replacing a grave marker that had LEST WE FORGET on the original grave marker.</p> <p>Figure 4.3d: Inscription format for Veterans' special order flat bronze marker. [C. Chandler, HCD, 2004]</p> | <p>Inscription: Roman lettering; all letters flat face, extending 2mm (3/32") above face of bronze plaque.</p> <p>Religious symbol: top 16mm (5/8") below commencement of bevelled edge. Latin Cross: size of cross: 64 x 38mm (2-1/2" x 1-1/2"), extending 5mm (3/16") above face of bronze plaque.</p> <p>1st line: 13mm (1/2") below bottom of Cross. Name and awards: Height of letters: 25mm (1"). Maximum 20 letter spaces per line. Use two lines if necessary.</p> <p>2nd line: 13mm (1/2") below name. Rank: Height of letters: 22mm (7/8"). Maximum 23 letter spaces.</p> <p>3rd line: 16mm (5/8") below rank. Unit or service: Height of letters: 22mm (7/8"). Maximum 23 letter spaces.</p> <p>4th line: 16mm (5/8") below unit. Date of death and age (or years of birth and death): Height of letters: 22mm (7/8"). Maximum 23 letter spaces. Use three letters for month.</p> <p>5th line: 19mm (3/4") below date. LEST WE FORGET: Height of letters: 25mm (1").</p> |
|---|--|

4.3.5 Inscription for Veterans' Special Order Cremation Markers

While the forms for veterans' cremation markers can follow individual cemetery specifications, their inscriptions should adhere to the specifications below:

Cross: If space permits.

1st line: Veteran's name and awards (if applicable); use two lines if necessary.

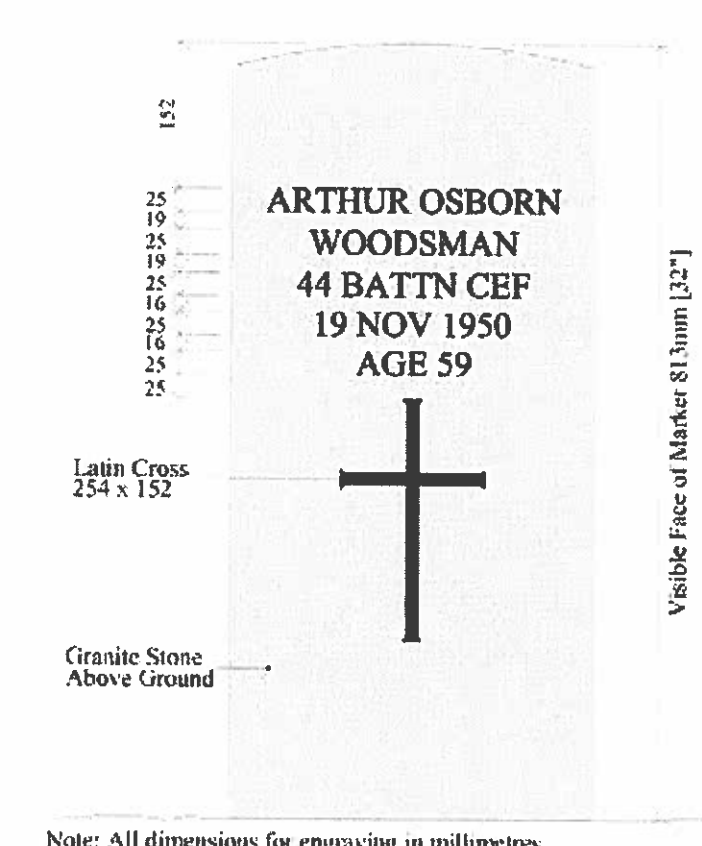
2nd line: Rank.

3rd line: Unit or Service.

4th line: Definitely containing date of death and age (or years of birth and death).

5th line: If space permits: "LEST WE FORGET". (Only applies if this was on the original marker)

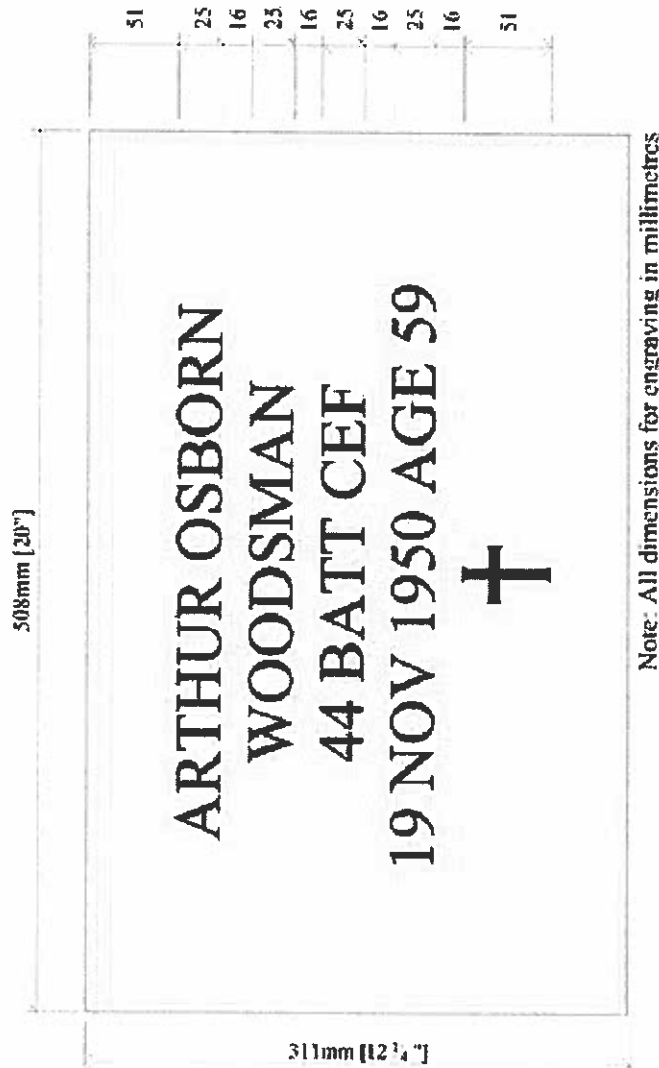
4.3.6 Inscription Format for VAC Civilian Upright Granite Markers

| | |
|---|---|
| <p>Elevation Not to scale</p> | <p>Inscription: Inscribing by sandblast process V-sunk, or by hand, to a minimum depth of 6mm (1/4"). Lettering: Smith Sip No. 2 or Monu-Cad No.69. No highlighting / painting of letters.</p> |
|  <p>Note: All dimensions for engraving in millimetres</p> | <p>Maximum letter spaces per line. 14 for all lines.</p> <p>1st line: 152mm (6") below top of marker. Name: Letter height: 25mm (1"). Use two lines if necessary, second line 19mm (3/4") below.</p> <p>2nd line: 19mm (3/4") below name. Rank: Letter height: 25mm (1").</p> <p>3rd line: 19mm (3/4") below rank. Unit: Letter height: 25mm (1"). Conflict may be added after unit only if space permits it.</p> <p>4th line: 16mm (5/8") below unit. Date of death: Letter height: 25mm (1"). Use three letters for month.</p> <p>5th line: 16mm (5/8") below date of death. Age: Letter height: 25mm (1")</p> <p>Religious symbol: Top: 25mm (1") below fifth line. Size: 254 x 152mm (10"x 6") Depth 16mm (5/8"). Another Religious Symbol may be substituted for the Cross, if requested by next-of-kin.</p> |
| <p>Figure 4.3e: Inscription format for VAC civilian upright granite markers. [C. Chandler, HCD, 2004]</p> | |

4.3.7 Inscription Format for VAC Civilian Flat Granite Markers

Plan View

Not to scale



Inscription: Inscribing by sandblast process V-sunk, or by hand, to a minimum depth of 6mm (1/4"). **Lettering:** Smith Sip No. 2 or Monu-Cad No.69. No highlighting / painting of letters.

Maximum letter spaces per line: 18 for all lines.

1st line: 51mm (2") below top of marker. **Name:** Letter height: 25mm (1"). Use two lines if necessary, second line 16mm (5/8") below.

2nd line: 16mm (5/8") below name. **Rank:** Letter height: 25mm (1").

3rd line: 16mm (5/8") below rank. **Unit:** Letter height: 25mm (1").

4th line: 16mm (5/8") below unit. **Date of death and age:** Letter height: 25mm (1"). Use three letters for month.

Religious symbol:

Top: 19mm (3/4") below fourth line. Size: 51 x 31mm (2"x 1-2/5"). Depth 10mm (3/8"). Another Religious Symbol may be substituted for the Cross, if requested by next-of-kin.

Figure 4.3f: Inscription format for VAC civilian flat granite markers. [C. Chandler, HCD, 2004]

4.3.8 Inscription Format for VAC Civilian Flat Bronze Markers

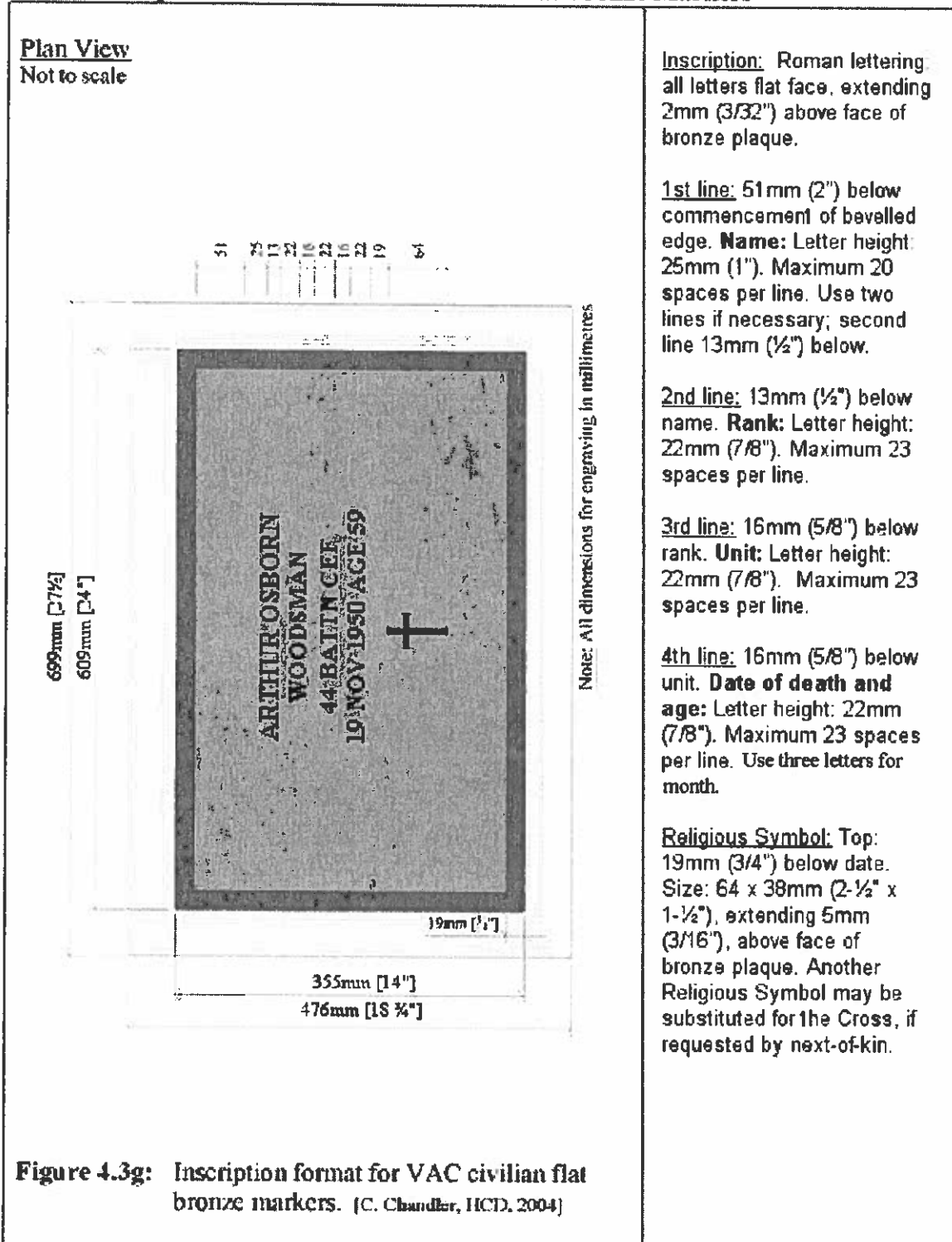
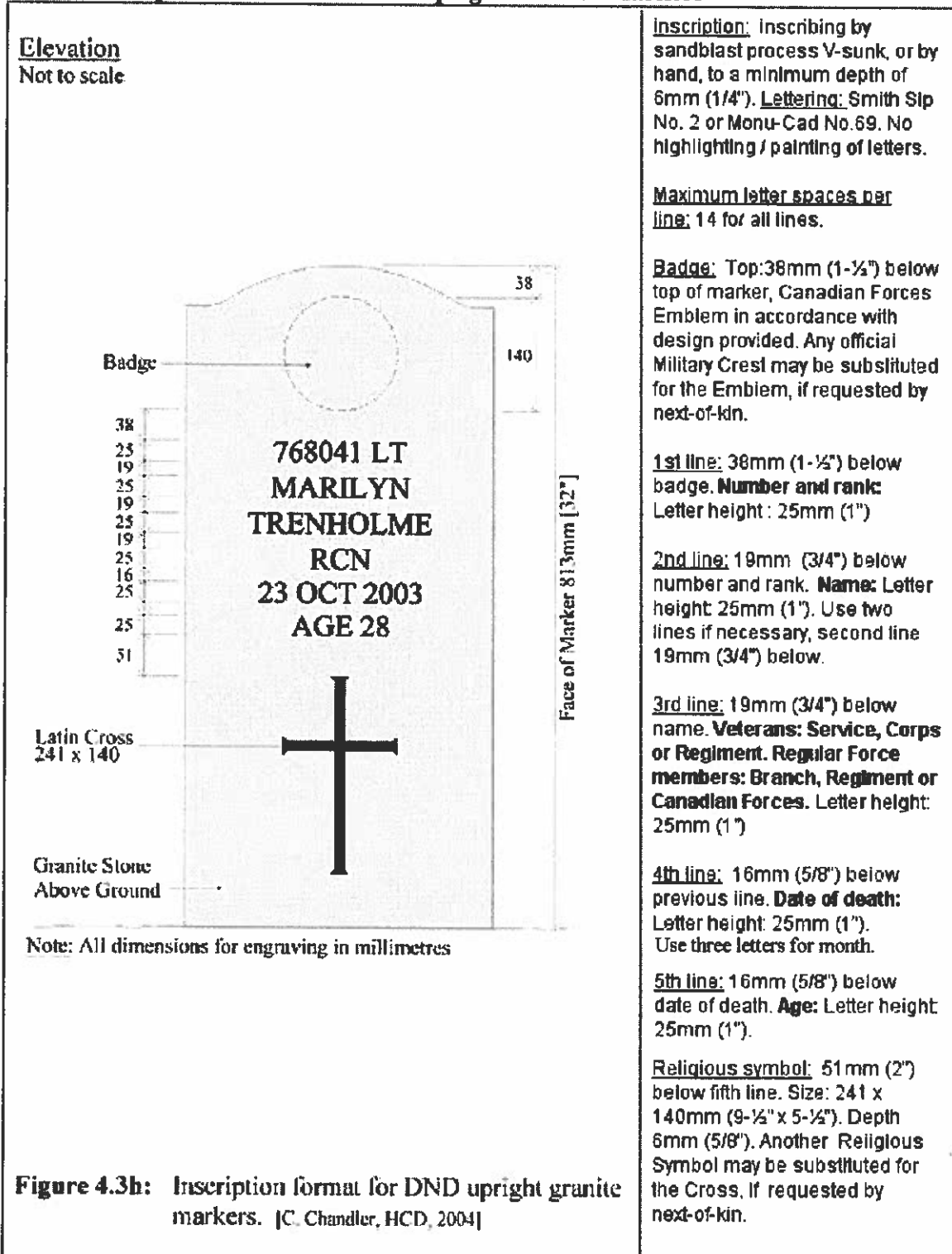


Figure 4.3g: Inscription format for VAC civilian flat bronze markers. (C. Chandler, HCD, 2004)

4.3.9 Inscription Format for DND Upright Granite Markers



Note: All dimensions for engraving in millimetres

Figure 4.3h: Inscription format for DND upright granite markers. [C. Chandler, HCD, 2004]

4.3.10 Inscription Format for DND Flat Granite Marker

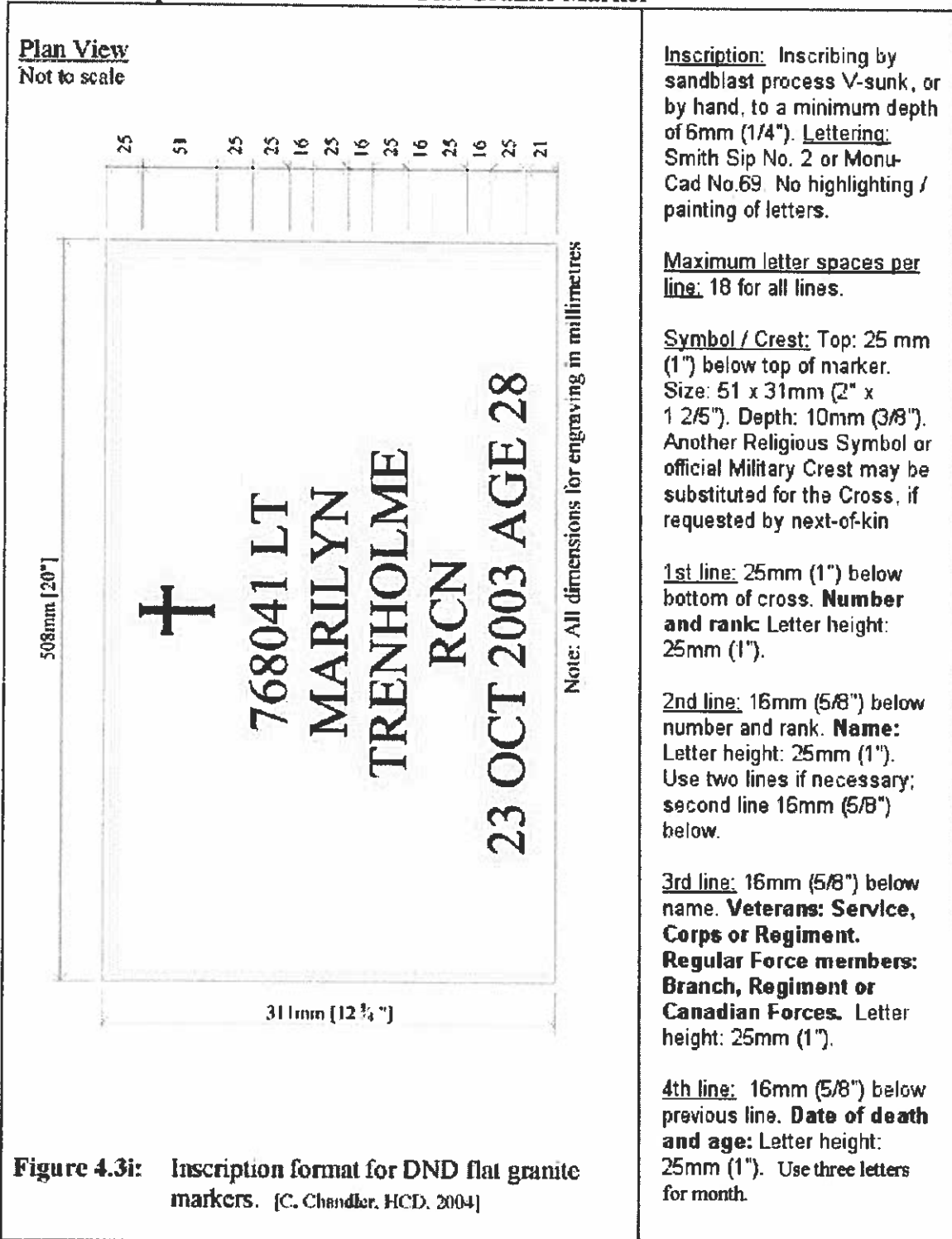
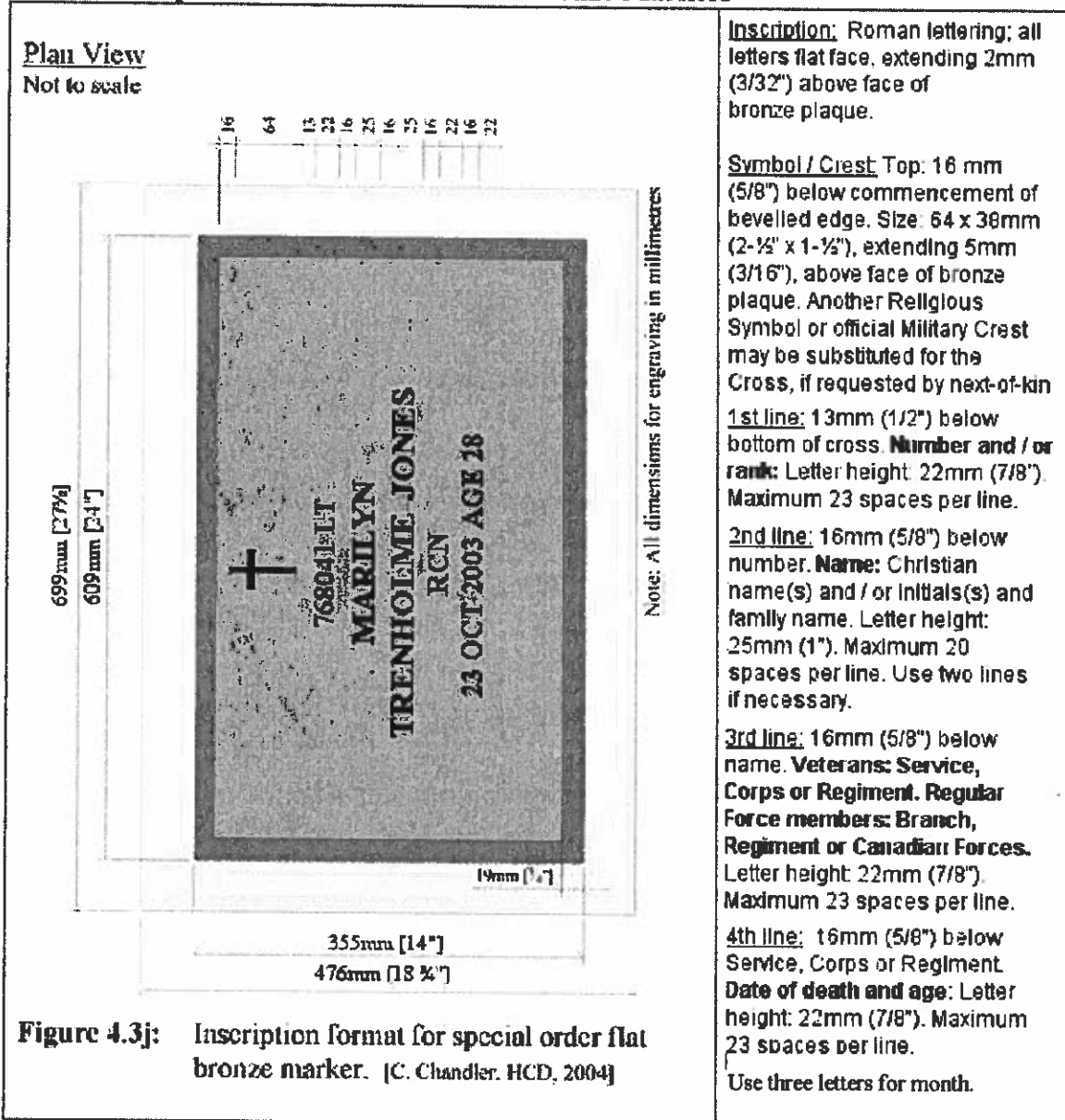


Figure 4.3i: Inscription format for DND flat granite markers. [C. Chandler, HCD, 2004]

4.3.11 Inscription Format for DND Flat Bronze Markers



4.3.12 Inscription Format for DND Cremation Markers

While the forms for DND cremation markers can follow individual cemetery specifications, their inscriptions should adhere to the specifications below:

Cross: If space permits.

- 1st line: Service personnel's name and awards if any.
- 2nd line: Awards, if need be, and rank.
- 3rd line: Rank, if need be, and unit.
- 4th line: Definitely containing years of birth and death.

4.3.13 Spousal Commemoration

VAC recognizes that the commemoration of spouses at the same gravesite is a common practice within Canada. To accommodate this custom VAC recommends that in response to family wishes, a veteran's spouse may be commemorated by means of a foot marker at the gravesite.

The specifications for the spousal commemoration are as follows:

- The size of the foot marker is to be 500 x 300 x 100mm (20" x 12" x 4").
- Material for the foot marker is to match the veteran's marker as to type of granite (Stanstead or Barre), or bronze on granite.
- Inscription to employ the same font used in the veteran's marker, whether Smith Sip No. 2 or Monu-Cad No. 69 with no highlighting of letters.
- Inscribing by sandblast process letters to be V-sunk, or by hand, to a minimum depth of 6mm (1/4").
- If a foot marker is not permissible by the cemetery authority, commemoration by another appropriate and dignified means, acceptable to the family/next of kin, VAC and the cemetery authority is possible. The instrument that commemorates the spouse/common-law partner should not detract or overshadow the eligible person's grave marker.
- If the commemoration inscription is to be on the existing grave marker the font size may be smaller than 25mm (1").

4.4 Grave Marker Foundations

Mounting a grave marker onto its foundation, as part of the installation process requires that three topics be considered: the foundation type (which includes consideration of soil type), the materials for the foundation and its installation, and the methods and materials for connecting the grave marker to the foundation. **Section 4.4.1** presents the recommended types of new grave marker foundations with their standards. **Section 4.4.2** presents the standards for the materials used to fabricate and install these foundations, and **Section 4.4.3** presents the standards for connecting the grave markers to their foundations.

4.4.1 Foundation Types

Three standard foundation types are recommended:

- single marker foundation pad,
- multiple marker beam-on-grade foundation, and
- multiple marker beam-on-pier foundation.

The selection of the foundation type for installation should be based on the type of soils present, the number and arrangement of markers to be installed, and whether the installation is a new installation or a restoration of an existing installation. The most appropriate emplacement method, buried or exposed, also needs to be considered for each type of foundation.

Deciding on the Foundation Type

Single marker foundation pads are appropriate in instances where the marker is isolated from other VAC markers. In this type of foundation, a reinforced concrete pad, solid granite block, or a compacted bed of granular fill spreads the weight of the marker over the soil and provides resistance against overturning of upright markers.

In general, single marker foundation pads should only be used when ongoing soil movement is not a problem, as for example, when the soil type is a free draining coarse soil or a free draining sandy soil. On-going movements in other soils will eventually shift a marker on this type of foundation out of alignment. Grave settlement will also typically be more pronounced in sandy, granular, non-cohesive soils and a single marker foundation pad used in this instance may shift out of vertical alignment as a result. When such misalignment does occur, however, the foundation and marker assembly can be re-leveled as a unit. The cost-benefit analysis for installing a group of single marker foundation pads versus installing a multiple marker foundation should thus include consideration for the soil conditions and the cost and effort involved in future re-leveling of markers on single foundations.

Multiple marker foundations are recommended in instances where there is a grouping of markers being installed, as for example within a Field of Honour. In this type of foundation, markers are supported in a line by a continuous reinforced concrete beam. The beam can be supported on a compacted layer of granular fill or on concrete or steel piers, which have been driven or cast into the soil.

Multiple marker beam-on-grade foundations utilize a continuous reinforced concrete beam supported on a compacted layer of granular fill. Beam-on-grade foundations are best suited for soils that are composed of reasonably free draining coarse or sandy materials. When used on soils that are highly organic, such as peat or organic silt, or soils that contain clays or fill material, a beam-on-grade foundation may eventually become misaligned as a result of soil movements. However this situation can be addressed to some degree through the design of the granular base for the foundation. Beam-on-grade foundations have been installed on highly organic soils in the past and have performed satisfactorily for ten or more years.

Multiple marker beam-on-pier foundations utilize a continuous reinforced concrete beam supported on concrete or steel piers, which have been driven or cast into the soil. Beam-on-pier foundations are best suited for use when restoring an existing beam-on-grade installation that has experienced on-going undesirable soil movements. In some situations, where local conditions warrant, a beam-on-pier foundation may be appropriate for use with a new installation. This includes situations where soil conditions are such that considerable beam-on-grade movement can be expected over a short time period.

The decision to install a beam-on-pier foundation in place of a beam-on-grade foundation should include a cost benefit analysis of the two foundation types. Because of the work involved in driving or casting piers, a beam-on-pier foundation is typically considerably

more expensive than a beam-on-grade foundation. This premium in cost becomes less of a factor when large numbers of foundations are being installed as the mobilization costs involved in constructing the piers become less significant relative to the total cost of the work. Beam-on-pier foundations may also require access for large equipment for drilling the pier holes or driving the piers into the ground, and the impact and feasibility of bringing such equipment into the cemetery must be considered.

Emplacement Method

Marker foundations can be buried or exposed, and the decision to bury or expose should be based on a consideration of several factors, including:

- original design intent for the cemetery landscape,
- evolution of the site or previous practice at the cemetery,
- topography of the cemetery, and
- type and number of markers.

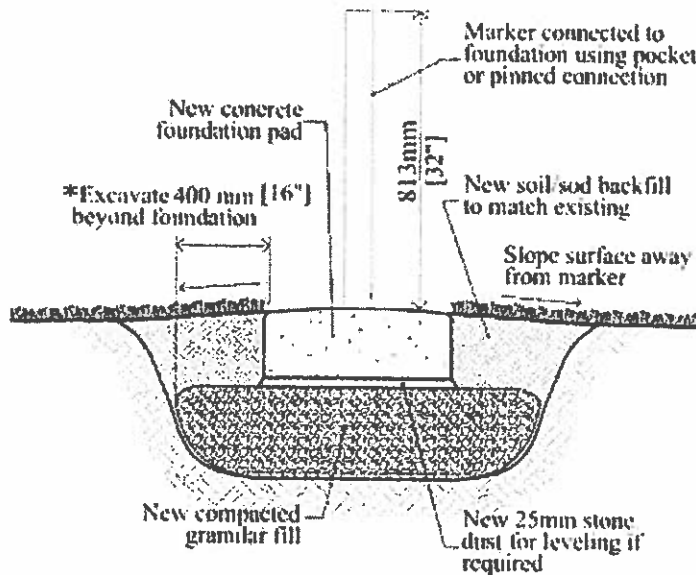
In evaluating the suitability of an exposed foundation, consideration should be given to the fact that exposing or raising the foundation above the grave surface has the benefit of reducing the risk of accidental damage to the markers from impacts with maintenance equipment as cutting the turfgrass right against the marker is eliminated. This can also reduce the time spent on mowing, and the need to water the turfgrass during dry periods.

Single Foundation Pads for Upright Granite Markers

The preferred foundation for single upright markers is a reinforced concrete pad supported by a prepared base of new free draining granular fill. Figure 4.4a (i), 4.4a (ii), and 4.4a (iii), below, detail the recommended installation procedure and the pads dimensions and reinforcement. If the emplacement is to be an exposed foundation, extra care must be taken in providing a proper finish to all of the exposed concrete surfaces.

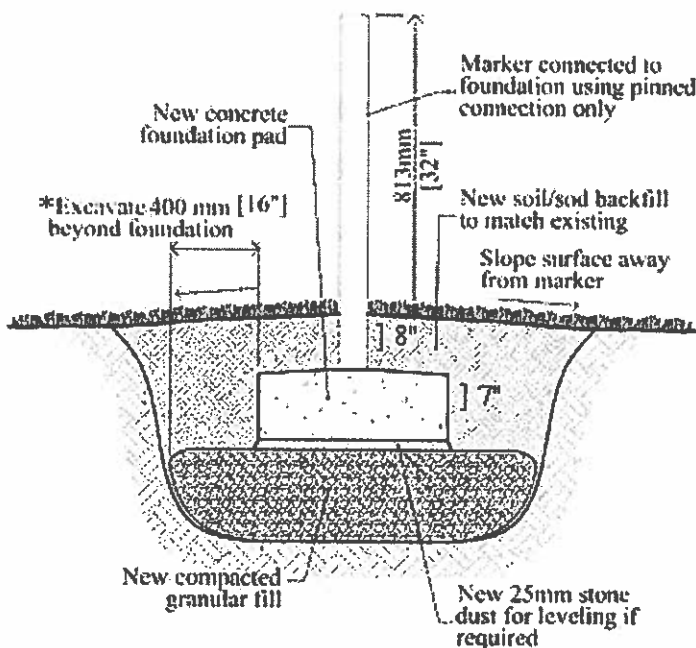
Exposed Emplacement

Not to scale



Buried Emplacement

Not to scale



Materials for Installation:

Reinforced concrete foundation pad. Refer to drawings 4.4a(ii) and (iii) for pad construction details.

New granular fill. For depth of new fill and compaction requirements refer to Section 4.4.2.

Wrap new granular fill in geotextile fabric, overlap joints 200mm minimum.

Use limestone screenings for stone dust.

Re-use existing sod or grave surface if suitable, otherwise provide new to match existing.

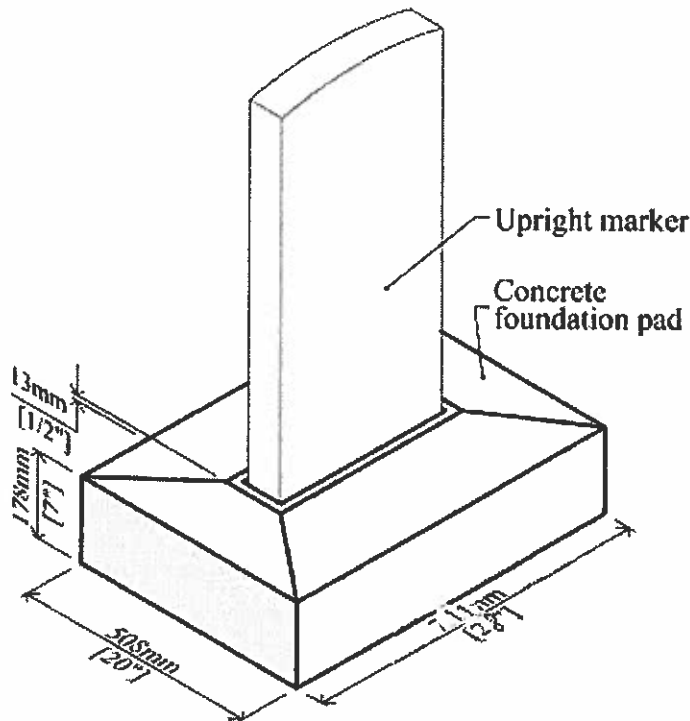
* Width of excavation for marker installation may be reduced to a minimum of 100 mm (4") on either side of the marker to avoid disruption to adjacent graves and to stay within grave boundaries.

**For Buried Emplacement marker length is 1016 mm (40") or more if necessary.

Figure 4.4a (f): Single foundation for upright marker
[C. Chandler, HCD, 2004].

Axonometric view

Not to scale



Materials for Installation:

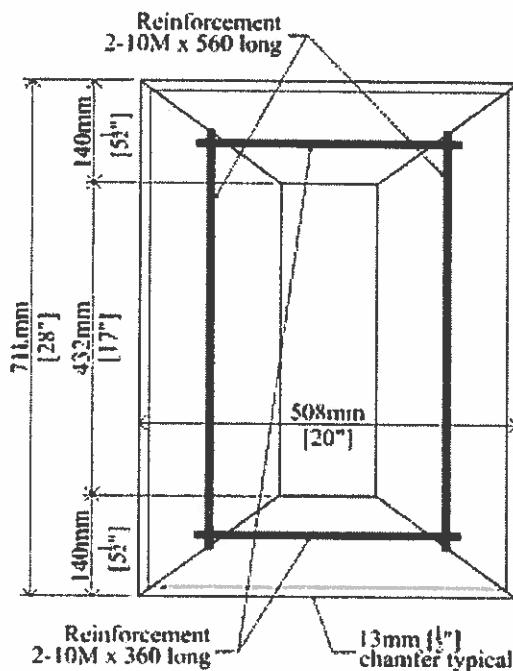
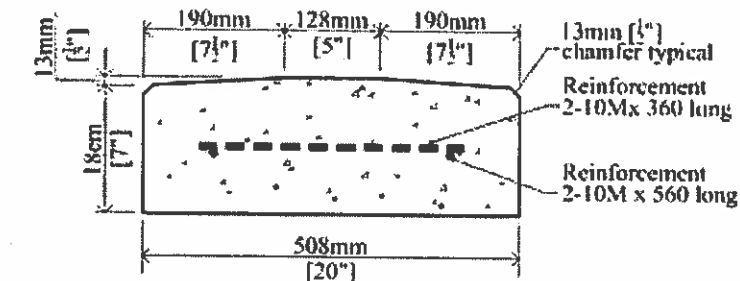
Reinforced concrete foundation pad. Refer to drawings 4.4a(iii) for pad construction and reinforcement details.

The exception to the size of the marker would be in replacing the marker within an existing row, where the base size would cause the new marker's centre to be out of alignment with other markers in that row.

Figure 4.4a (ii): Single foundation for upright marker
[C. Chandler, HCD, 2004].

Dimensions and Reinforcement

Not to scale



Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

13mm [1/2"] chamfer not necessary for buried emplacements.

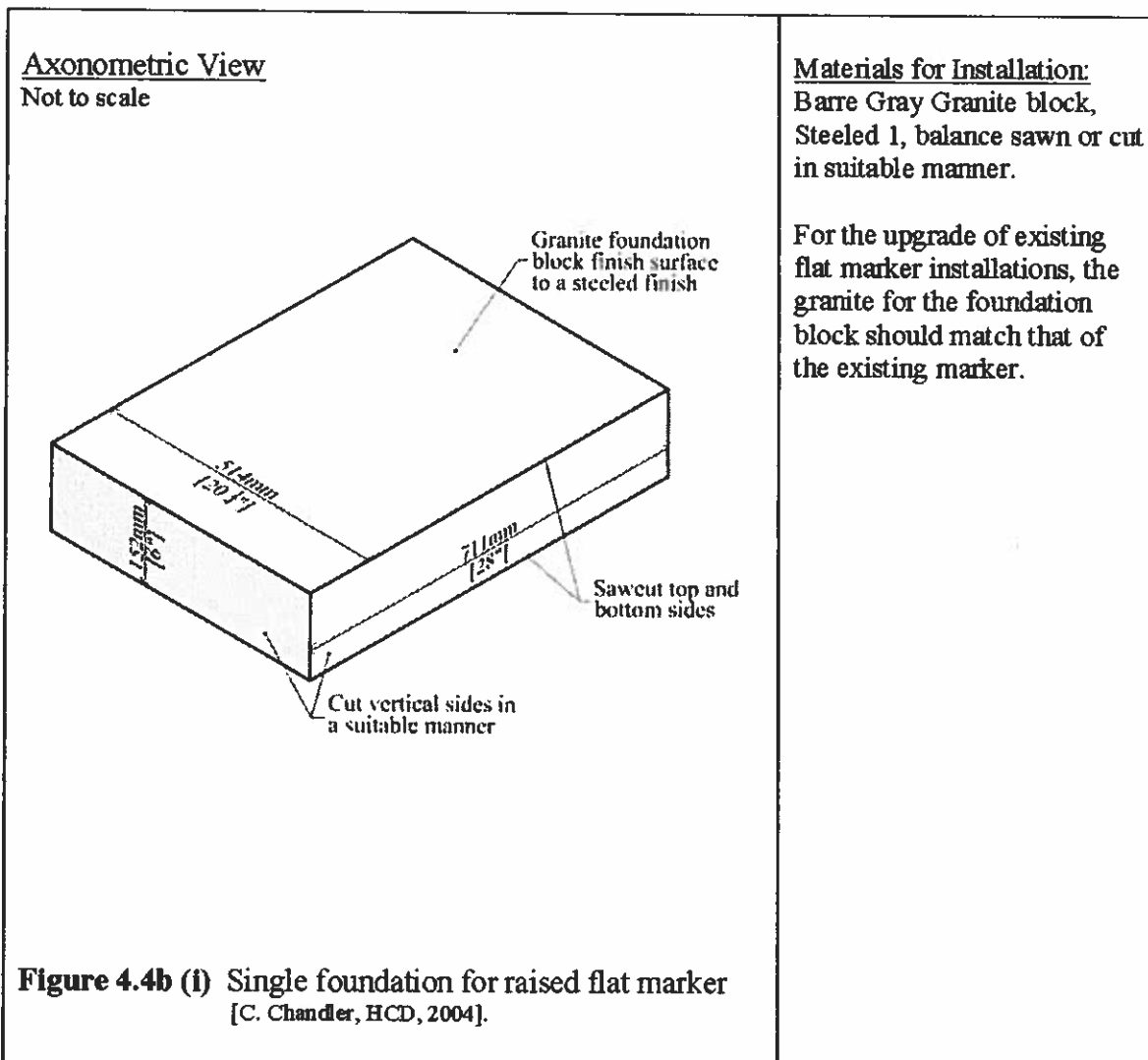
For markers with 6" thickness to meet some Ontario Cemetery requirements:

1. Increase the width of the flat ledge on top of the pad from 127mm [5"] to 203mm [8"].

Figure 4.4a (III): Single foundation for upright marker
[C. Chandler, HCD, 2004].

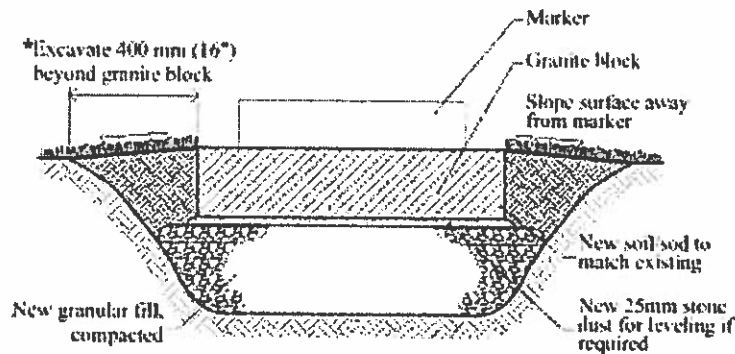
Single Foundation Pads for Flat Granite Markers The preferred foundation for a single flat marker is a solid granite block supported on a prepared base of new free draining granular fill. Figure 4.4b (i) below, details the foundation block's dimensions. An alternative to the granite block foundation, for installations where the face of the marker is set flush with the grave surface, involves setting the marker on a bed of compacted granular fill only, with no intermediate granite block foundation pad. This alternative installation is also suitable for instances where existing flat markers are being re-set.

Figure 4.4b (ii) details the emplacement methods for both foundation types.



Emplacement With Granite Block Foundation

Not to scale



Emplacement With Compacted Granular Fill Foundation

Not to scale

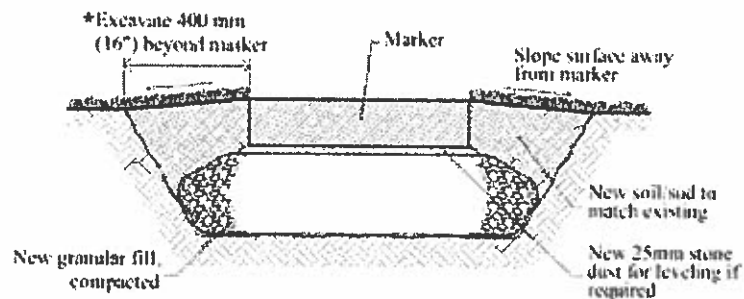


Figure 4.4b (ii) Single foundation for flat marker.
[C. Chandler, HCD, 2004].

Materials for Installation:

Barre Gray Granite block,
Steeled 1, balance sawn or cut
in suitable manner.

For the upgrade of existing
flat marker installations, the
granite for the foundation
block should match that of
the existing marker.

New granular fill. For depth
of new fill and compaction
requirements refer to Section
4.4.2.

Wrap new granular fill in
geotextile fabric, overlap
joints 200mm minimum.

Use limestone screenings for
stone dust.

Re-use existing sod or grave
surface if suitable, otherwise
provide new to match
existing.

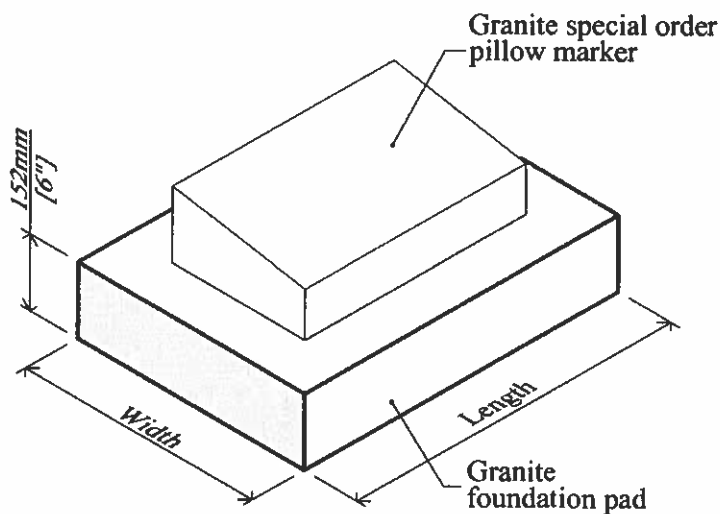
* Width of excavation for
marker installation may be
reduced to a minimum of
100 mm (4") on either side
of the marker to avoid
disruption to adjacent graves
and to stay within grave
boundaries.

Single Foundation Pad for Special Order Marker

The preferred foundation for a single special order marker, which can include the bronze, pillow, scroll, and wedge marker forms, is similar to the solid granite block foundation used for single foundation for raised flat markers. Figures 4.4c(i) and (ii), below, detail the blocks dimensions and recommended installation procedure.

Axonometric View

Not to scale



Dimensions of Granite Block:

Pillow Marker

Width: 562mm [22-1/8"]

Length: 930mm [36-5/8"]

Bronze Marker

Width: 679mm [26-3/4"]

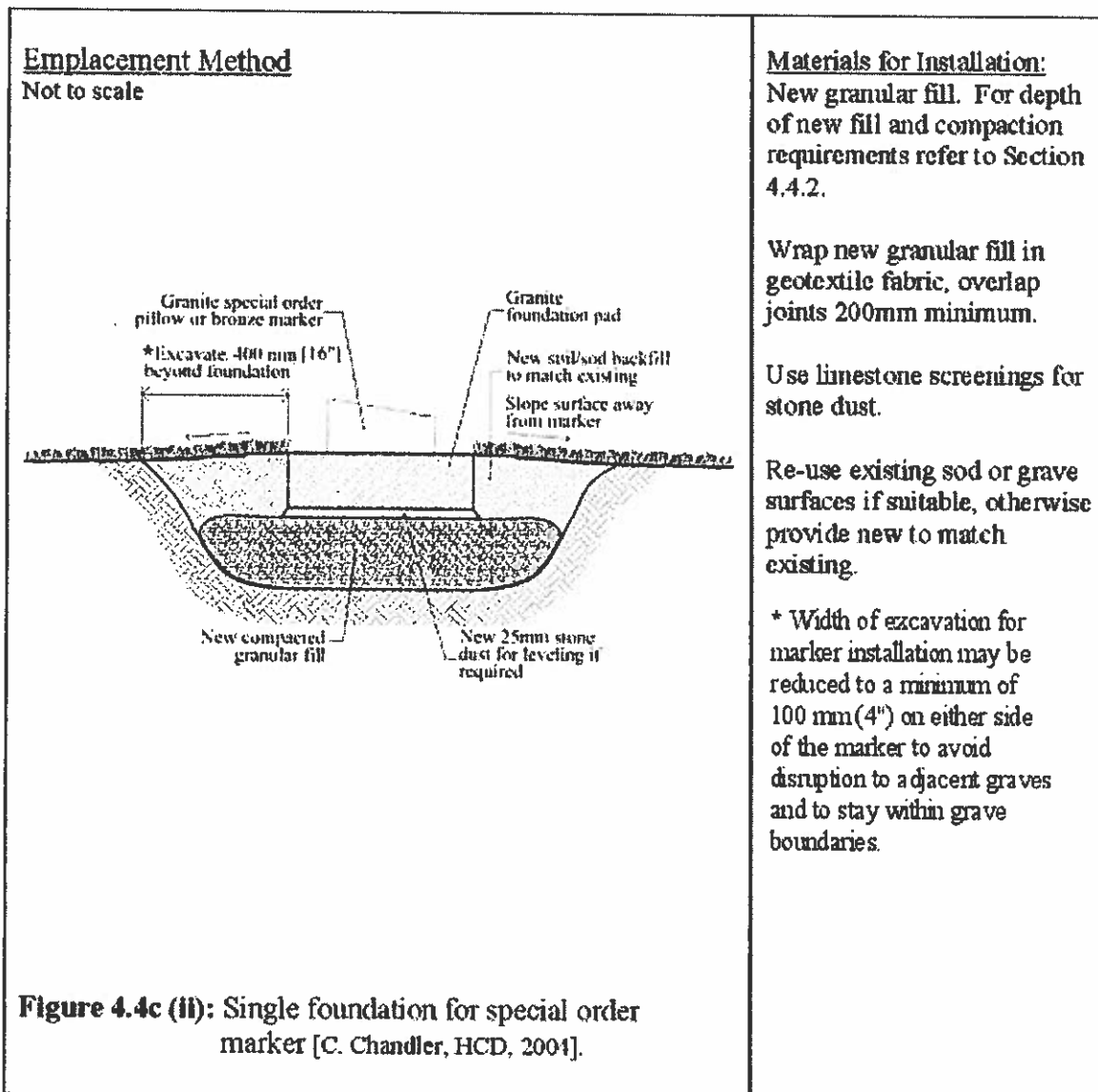
Length: 902mm [35-1/2"]

Materials for Installation:

Barre Gray Granite block,
Steeled 1, balance sawn or cut
in suitable manner.

For the upgrade of existing flat
marker installations, the
granite for the foundation
block should match that of the
existing marker.

Figure 4.4c(i): Single foundation for special order
marker [C. Chandler, HCD, 2004].

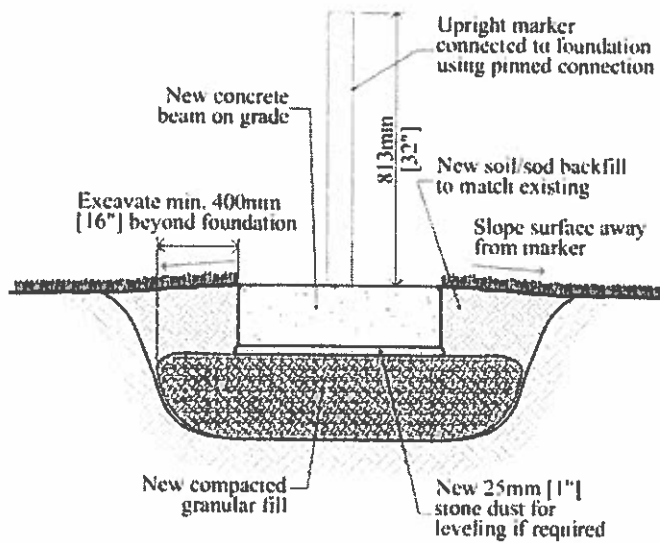


Beam-on-Grade Foundation for Multiple Upright Markers

The preferred foundation for multiple upright markers is a reinforced concrete beam-on-grade foundation on a prepared base of new free draining granular fill. The dimensions of the foundation beam are the same for both buried and exposed emplacement conditions. Figure 4.4d (i) details the recommended installation procedures. If the emplacement is to be an exposed foundation, extra care must be taken in providing a high quality finish to all of the exposed faces of the concrete surfaces. Figure 4.4d (ii) details the dimensions of the beam and treatment between adjoining foundation beams. Figure 4.4d (iii), details the dimensions and reinforcement of the concrete beam.

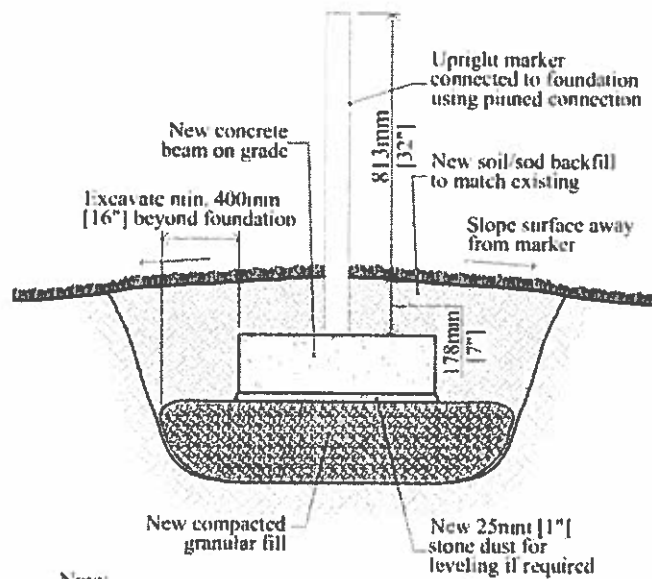
Exposed Emplacement

Not to scale



Buried Emplacement

Not to scale



Note:
Grouted pocket connections are not suitable for this installation type

Materials for Installation:

Reinforced concrete beam.

Refer to drawing 4.4d (ii) and (iii) for beam dimensions and details.

New granular fill. For depth of new fill and compaction requirements refer to Section 4.4.2.

Wrap new granular fill in geotextile fabric, overlap joints 200mm minimum.

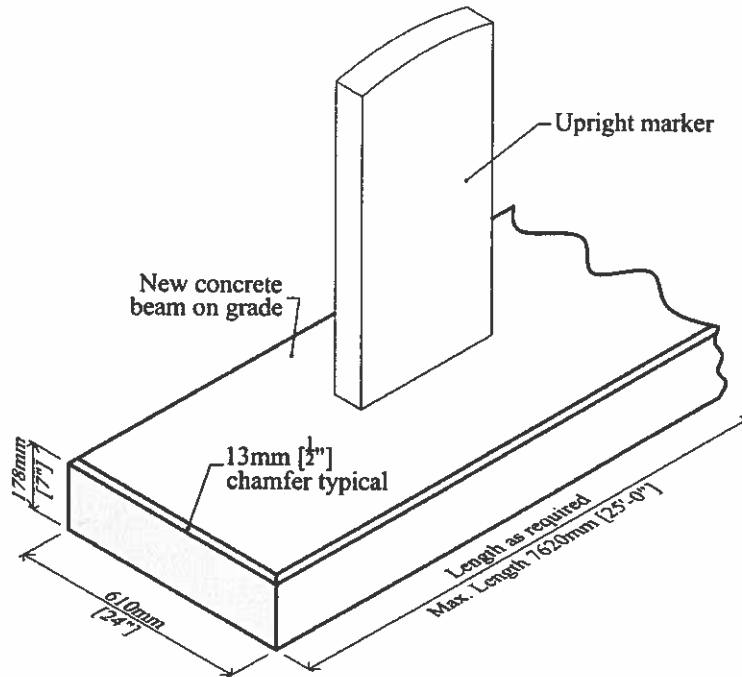
Use limestone screenings for stone dust.

Re-use existing sod or grave surfaces if suitable, otherwise provide new to match existing.

Figure 4.4d (i): Beam-on-grade foundation for multiple upright markers [C. Chandler, HCD, 2004]

Axonometric View

Not to scale



Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

13mm [1/2"] chamfer not necessary for buried emplacement.

Cross Section and Reinforcement

Not to scale

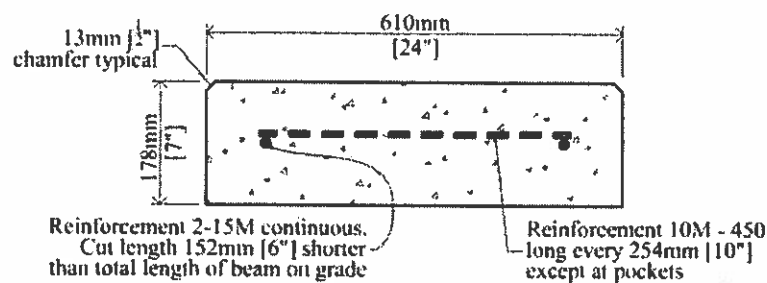
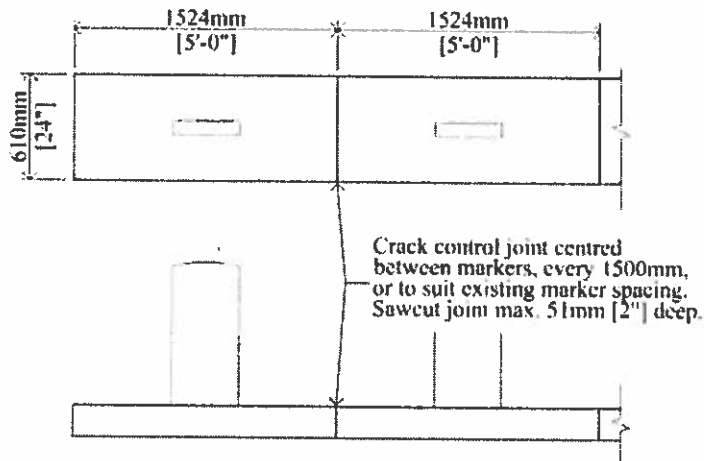


Figure 4.4d (ii): Beam-on-grade foundation for multiple upright markers [C. Chandler, HCD, 2004]

Beam Dimensions

Not to scale



Detail at Joint between Beams

Not to scale

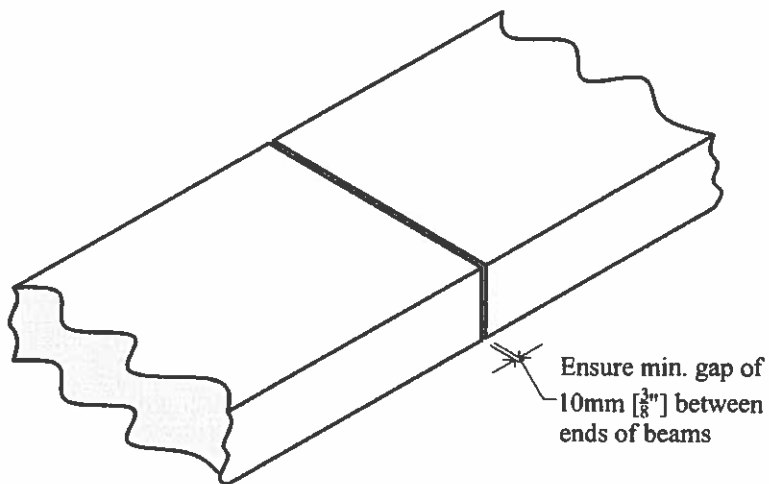


Figure 4.4d (iii): Beam-on-grade foundation for multiple upright markers [C. Chandler, HCD, 2004].

Materials for Installation:

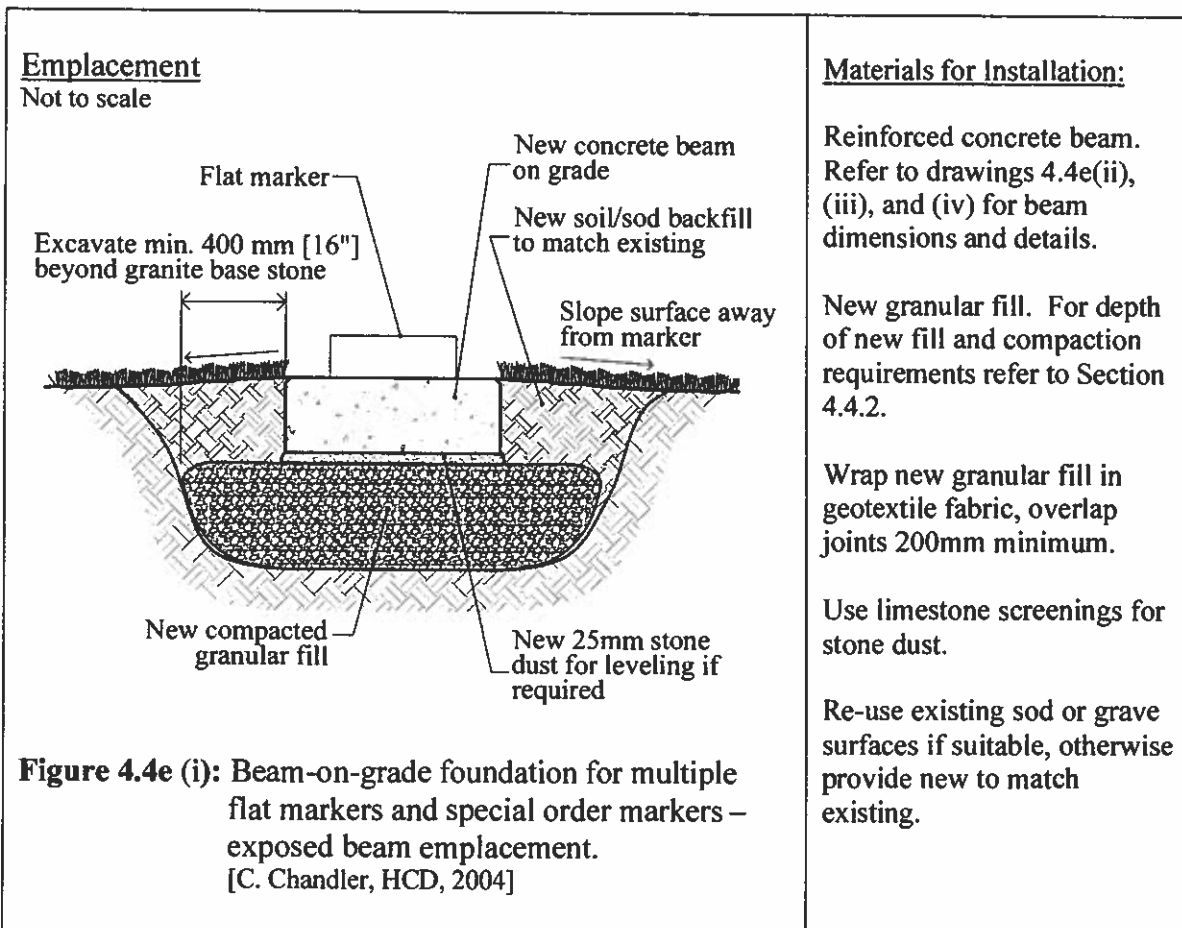
Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Beam-on-Grade Foundation for Multiple Flat Markers and Multiple Special Order Markers

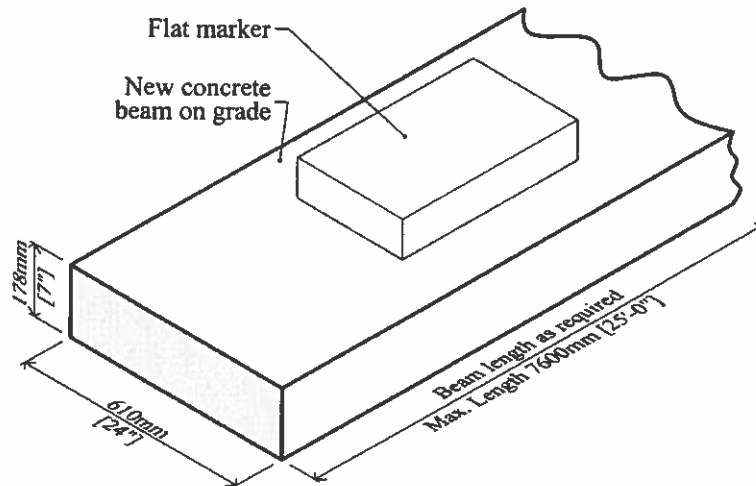
The preferred foundation for multiple flat markers is a reinforced concrete beam-on-grade foundation supported by a prepared base of new free draining granular fill. The dimensions and shape of the foundation beam will differ depending on whether the foundation beam is to be buried or exposed. In the case of an exposed emplacement, the installation procedure and concrete beam dimensions and reinforcement are detailed in Figure 4.4e (i), (ii), (iii), and (iv) below.

In the case of a buried emplacement, the concrete beam dimensions, reinforcing, and installation procedures differ significantly. Furthermore, in a buried beam emplacement there are two options to consider for placement of the marker: the entire marker is raised above the turfgrass on a concrete pad, or the face of the marker is set flush with the turfgrass. The raised marker is the preferred installation for minimizing damage to the markers from mowing operations and the foundation beam is detailed in Figure 4.4f (i), (ii), (iii), and (iv) below. The foundation beam for buried emplacement, where the marker is flush with the turfgrass, is detailed in Figure 4.4g (i), (ii), (iii), and (iv) below.



Axonometric View

Not to scale



Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Beam Reinforcement

Not to scale

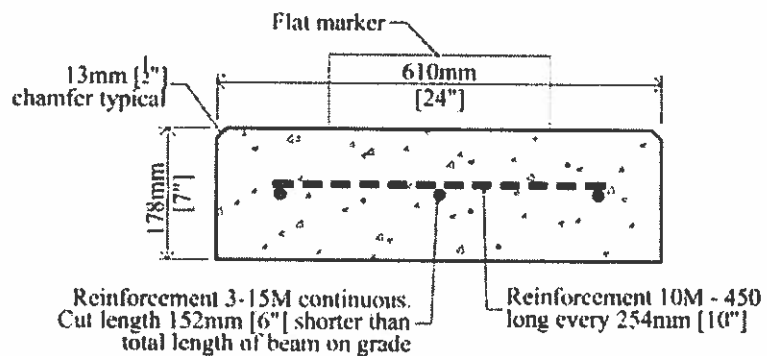
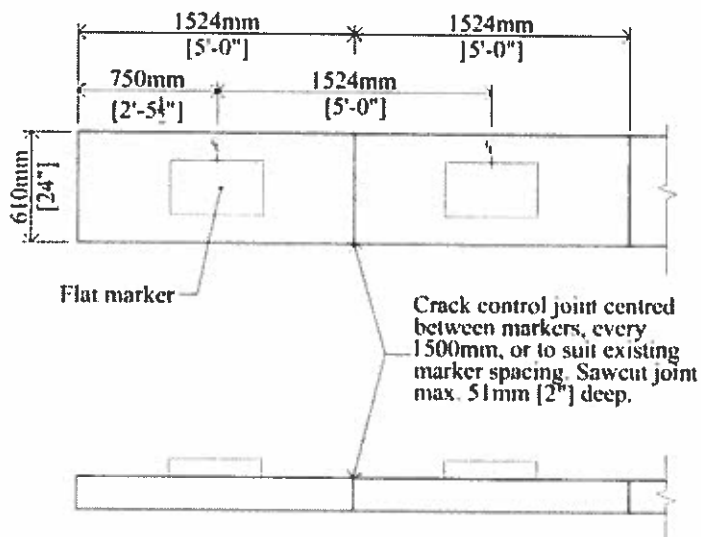


Figure 4.4e (ii): Beam-on-grade foundation for multiple flat markers and special order markers – exposed beam emplacement.
[C. Chandler, HCD, 2004]

Beam Dimensions

Not to scale



Materials for Installation:

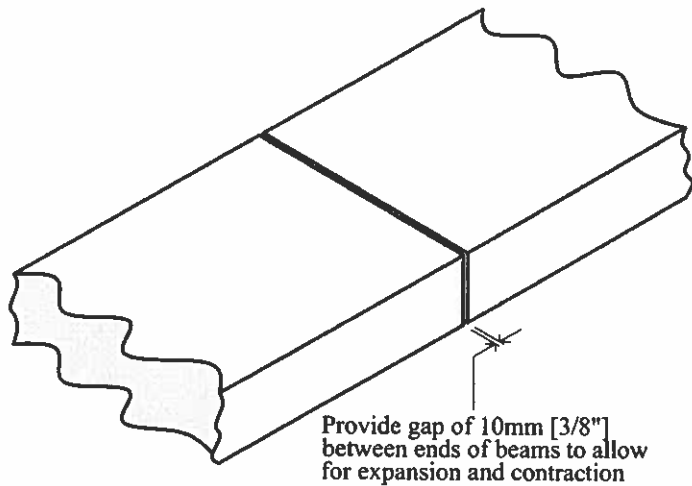
Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Figure 4.4e (iii): Beam-on-grade foundation for multiple flat markers and special order markers – exposed beam emplacement.
[C. Chandler, HCD, 2004]

Detail at Joint Between Beams

Not to scale



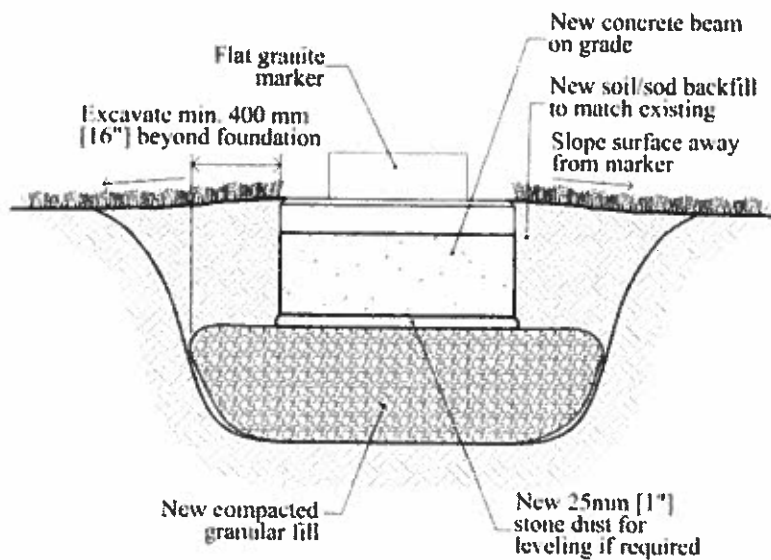
Materials for Installation:

Place 10mm thick fibreboard in
joint to prevent joint from filling
with debris.

Figure 4.4e (iv): Beam-on-grade foundation for multiple
flat markers and special order markers –
exposed beam emplacement.
[C. Chandler, HCD, 2004]

Emplacement

Not to scale



Beam Reinforcement

Not to scale

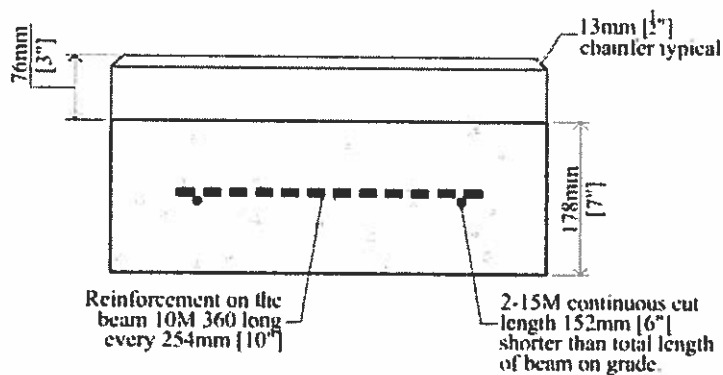


Figure 4.4f (I): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker raised above turfgrass [C. Chandler, HCD, 2004].

Materials for Installation:

Reinforced concrete beam. Refer to drawings 4.4f (ii), (iii), and (iv) for beam dimensions and details.

New granular fill. For depth of new fill and compaction requirements refer to Section 4.4.2.

Wrap new granular fill in geotextile fabric, overlap joints 200mm minimum.

Use limestone screenings for stone dust.

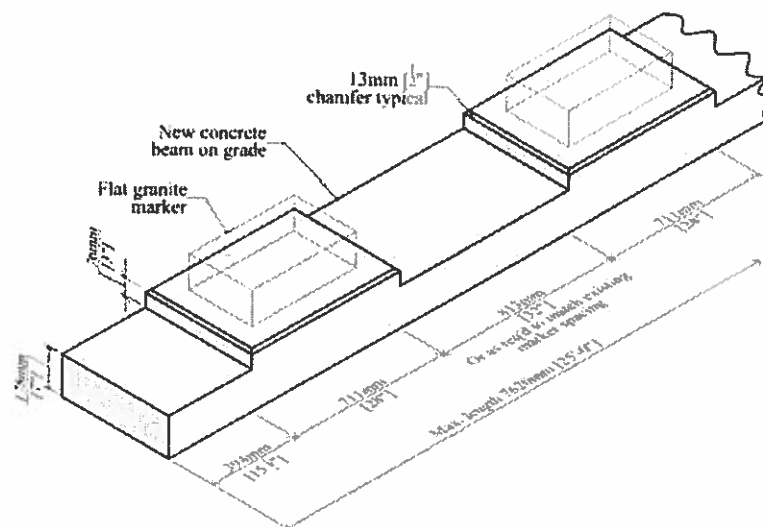
Re-use existing sod or grave surfaces if suitable, otherwise provide new to match existing.

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Axonometric View

Not to scale



Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Figure 4.4f (ii): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker raised above turfgrass [C. Chandler, HCD, 2004].

Beam Dimensions

Not to scale

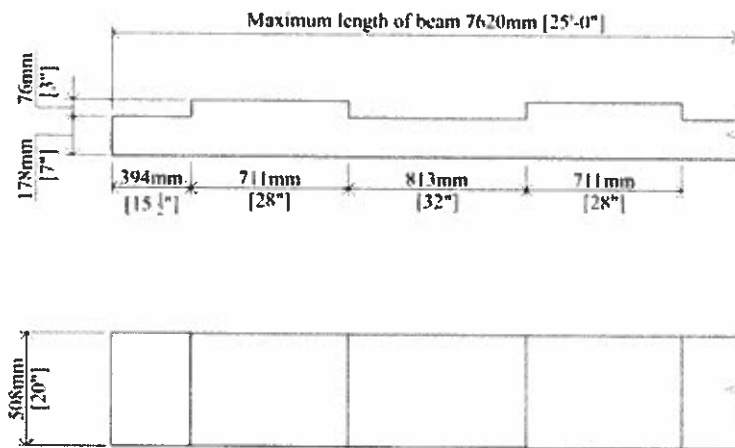


Figure 4.4f (iii): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker raised above turfgrass [C. Chandler, HCD, 2004].

Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Dimensions for Special Order Markers:

Pillow Marker

Width of Beam: 562mm [22-1/8"]

Length of Upstand: 930mm [36-5/8"]

Bronze Marker

Width of Beam: 679mm [26-3/4"]

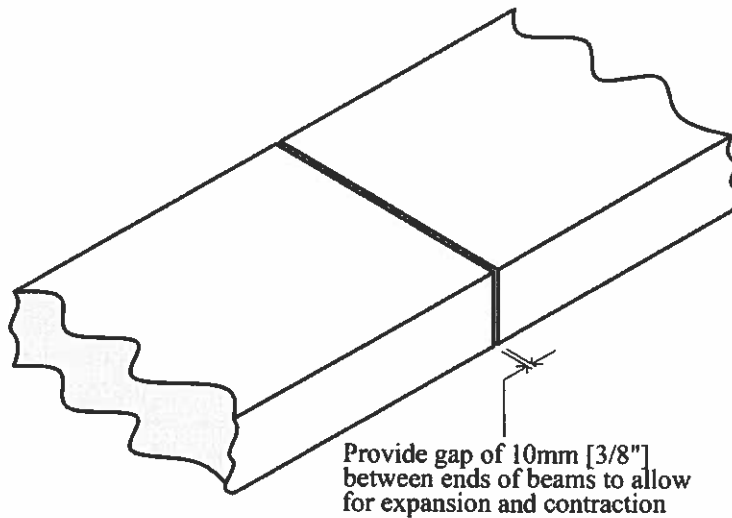
Length of Upstand: 902mm [35-1/2"]

Longitudinal Reinforcement for Special Order Bronze Markers:

Increase reinforcement to 2-15M continuous.

Detail at Joint Between Beams

Not to scale



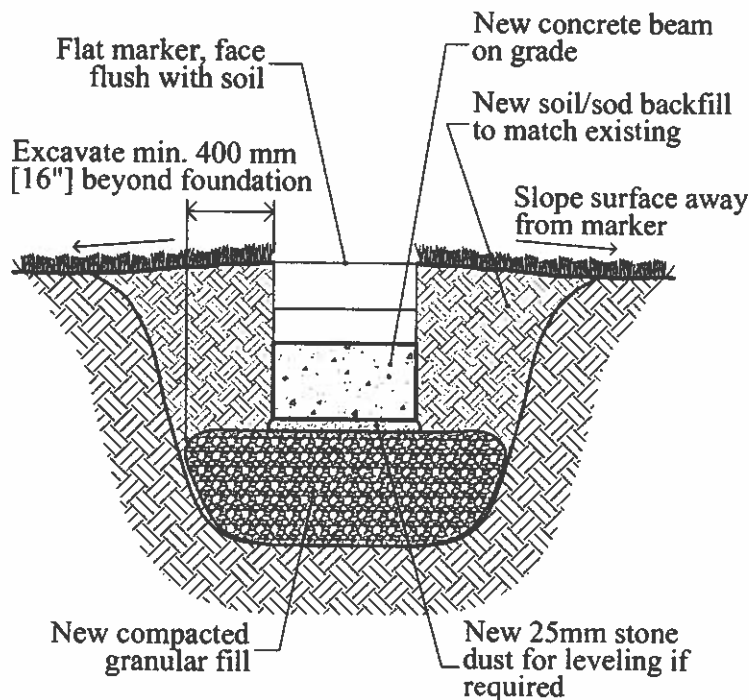
Materials for Installation:

Place 10mm thick fibreboard in
joint to prevent joint from filling
with debris.

Figure 4.4f (iv): Beam-on-grade foundation for flat
markers and special order markers –
buried emplacement marker raised
above turfgrass [C. Chandler, HCD, 2004].

Emplacement

Not to scale



Beam Reinforcement

Not to scale

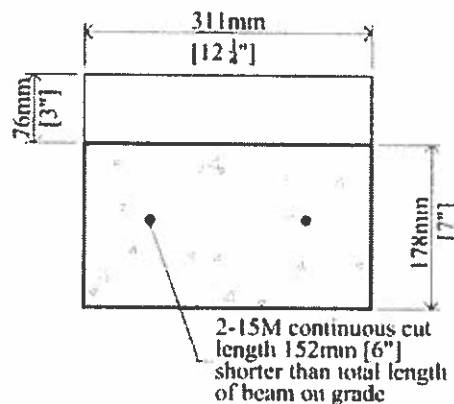


Figure 4.4g (i): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker flush with turfgrass [C. Chandler, HCD, 2004].

Materials for Installation:

Reinforced concrete beam. Refer to drawings 4.4g (ii), (iii), and (iv) for beam dimensions and details.

New granular fill. For depth of new fill and compaction requirements refer to Section 4.4.2.

Wrap new granular fill in geotextile fabric, overlap joints 200mm minimum.

Use limestone screenings for stone dust.

Re-use existing sod or grave surfaces if suitable, otherwise provide new to match existing.

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Axonometric View

Not to scale

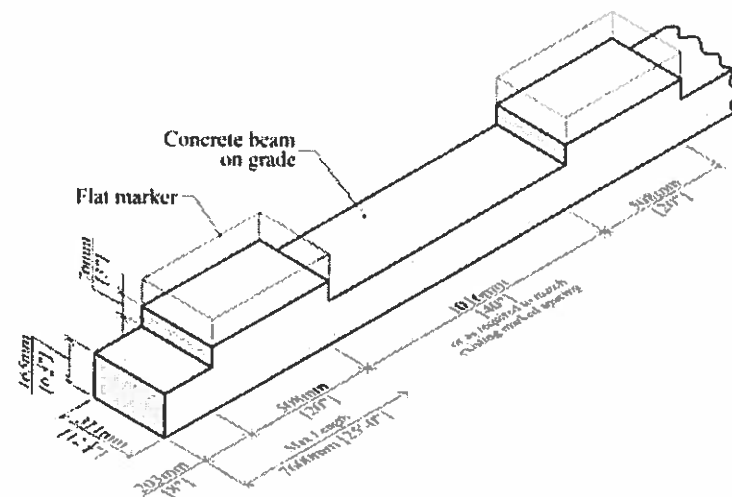


Figure 4.4g (ii): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker flush with turfgrass [C. Chandler, HCD, 2004].

Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Beam Dimensions

Not to scale

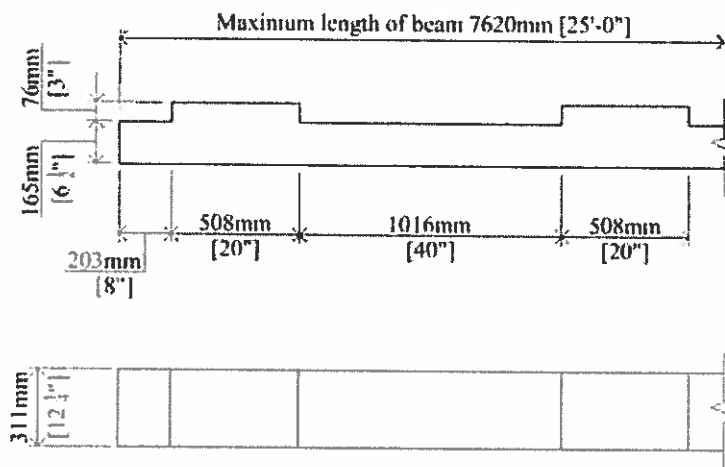


Figure 4.4g (iii): Beam-on-grade foundation for flat markers and special order markers – buried emplacement marker flush with turfgrass [C. Chandler, HCD, 2004].

Materials for Installation:

Concrete to match specifications in Section 4.4.2 to match soil conditions of the site.

Reinforcement to match specifications in Section 4.4.2.

Dimensions for Special Order Markers:

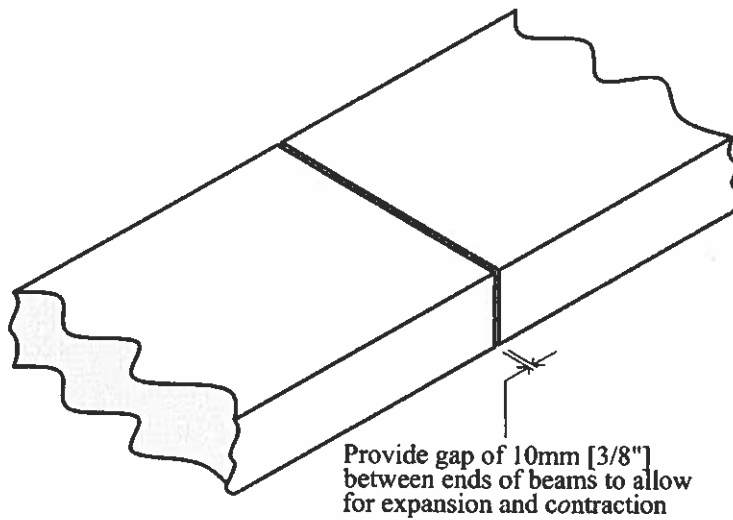
Bronze Marker

Width of Beam: 476mm [18-3/4"]

Length of Upstand: 699mm [27-1/2"]

Detail at Joint Between Beams

Not to scale



Materials for Installation:

Place 10mm thick fibreboard in
joint to prevent joint from filling
with debris.

Figure 4.4g (iv): Beam-on-grade foundation for flat
markers and special order markers –
buried emplacement marker flush with
turfgrass [C. Chandler, HCD, 2004].

Beam-on-Pier Foundations for Multiple Upright, Flat and Special Order Markers

The preferred foundation for multiple markers where beam-on-grade foundations are known to not perform satisfactorily, or where soil conditions are such that considerable beam-on-grade foundation movement can be expected over a short time period, is a reinforced concrete beam-on-pier foundation.

The design of this type of foundation system requires consideration for the unique specific site conditions present, including the length of the beam, the number and location of the piers, and the soil type. The following general standards are the basis for the design of this type of foundation; however, specialist professional engineering advice must be obtained to complete the design of the reinforcing and the foundation piles.

The recommended shape of the concrete beam for upright, flat and special order markers, with an exposed emplacement, and for upright markers with a buried emplacement is similar to the beam-on-grade foundation detailed in Figure 4.4d, above.

The recommended shape of the concrete beam for flat markers and special order markers with a buried emplacement is similar to the beam-on-grade foundations detailed in Figure 4.4f and 4.4g, above.

The only difference between the dimensions of the beam-on-grade foundations illustrated previously and the beam-on-pier foundations should be the thickness of the beam, which may need to be increased beyond the thickness shown to increase the beams strength and stiffness. The width of the beam should not be increased as a way of increasing its strength. The strength of the concrete mix may also need to be adjusted to achieve the required beam strength and any revisions to the standard mix design should match it in terms of durability.

If the emplacement is to be an exposed foundation, extra care must be taken in providing a proper finish to all of the exposed faces of the beam.

4.4.2 Foundation Materials

Concrete

The following concrete mix designs are appropriate for use with individual upright marker foundations and with multiple marker beam-on-grade type foundations. These concrete mix designs are also suitable for multiple marker beam-on-pier type foundations; however, because of the unique nature of these types of foundations, the design engineer may need to deviate from these mixes to meet the specific design criteria for the beams and piers in question.

Mass produced marker foundations using pre-cast techniques or pre-stressed beam designs may also require some deviation from these mixes to accommodate the different casting procedures followed in this type of manufacture. In such an instance, the pre-cast manufacturing company should use these mixes as a guideline in developing their mix

design and the revised concrete mix should match these designs in durability and performance.

Any changes or revisions to the mix design and placement procedures and recommendations listed below should follow the CSA Standard A23.1, *Concrete Materials and Methods of Concrete Construction*, as a guideline.

Concrete standards for soils that are known to contain sulphates:

- minimum 35 MPa compressive strength;
- maximum water/cement ratio 0.4;
- use Type 20 Moderate Cement if water soluble sulphate (SO₄) in soil measures between 0.1 and 0.2 %, or sulphates in ground water measure between 150 and 1500 mg/litre;
- use Type 50 Sulphate Resistant Cement if water soluble sulphate (SO₄) in soil measures greater than 0.2 %, or sulphates in ground water measure greater than 1500 mg/litre;
- air entrainment 5% to 8%;
- slump 80mm.

Do not use calcium chloride or any admixture containing calcium chloride if the soil is known to contain sulphates.

Concrete standards for all other soils:

- minimum 35 MPa compressive strength;
- maximum water/cement ratio 0.4;
- use Type 10 Normal Cement;
- air entrainment 5% to 8%;
- slump 80mm.

In locations where drainage of the ground water is problematic and the number of freeze thaw cycles is high, using cements that contain Silica Fume can improve the durability of the concrete by reducing its permeability. Silica Fume cement has the designation SF added to the cement type, thus use Type 10 SF, Type 20 SF or Type 50 SF as appropriate for the sulphate conditions noted above.

Water used in mixing all concrete should be clear and free of oils, acids, alkalies, soluble chlorides, organic matter and sediment.

Fine aggregate for the concrete mix should consist of natural sand, manufactured sand or a combination of both. Coarse aggregate should be no larger than 38mm (1 ½") in diameter. All aggregate should be free of organic impurities.

Aggregates should not react with alkalies contained in the concrete. Premature deterioration of the concrete can occur as a result of a reaction between minerals in some

rock types and the soluble alkaline components in the concrete. This is typically a regional problem resulting from the use of a particular rock as an aggregate. The source of the aggregate should be contacted to confirm that alkali-aggregate reaction is not a problem and that the aggregate conforms to the CSA Standard A23.1, *Concrete Materials and Methods of Concrete Construction*.

Concrete can be cast on site, or pre-cast off site. When feasible, the use of pre-cast concrete is preferred. Pre-cast concrete typically possesses superior finishing, weathering and strength characteristics over cast-in-place concrete, because of the greater ability to easily maintain uniform quality control and curing conditions in the controlled environment of a pre-cast facility. In situations where reasonably large quantities of foundations are being cast, pre-cast concrete should not involve a significant cost premium over cast in place concrete, in smaller batches, however, pre-cast concrete could be more expensive than cast in place. Cast-in-place concrete can approach the quality and performance of pre-cast concrete if properly formed, mixed, placed and cured.

When casting concrete it must be placed within properly constructed wooden or metal forms as follows:

- When casting on site, the earthen sides of the excavated foundation pit should not be used as the form to shape the concrete mass.
- Formwork should be adequately fixed in place using wooden stakes and blocking to ensure that straight true lines are formed, and that the formwork does not shift or sag after the concrete has been placed.
- The formwork should be coated with a form release or parting agent that is non-staining and non-volatile prior to casting the concrete. This will ensure easy removal of the formwork. If no release agent is used prior to casting, the formwork should be dampened with water prior to placing the concrete.
- Before casting the concrete, clean the form of any organic matter, ice or snow prior to placing the concrete.
- Careful stripping of formwork is required, so as not to accidentally chip or mar any surfaces of concrete that is intended to be exposed. Strip the formwork only after the concrete has gained sufficient strength, which usually takes 2 to 3 days.
- When casting concrete on site, wet the granular base prior to placing the concrete. Standing water should not be present.
- Use vibrators to ensure complete consolidation of the concrete and to prevent segregation, honeycombing or voids.

- When casting on site, do not bury or leave the wooden formwork in place after curing, always remove the formwork for re-use or disposal.
- Complete the placement of the concrete within 1-½ hours from the time water was first added to the dry material.
- When placing large amounts of concrete, take precautions to prevent cold joints forming between pours. Cold joints occur when concrete that is placed in the form is allowed to cure somewhat before the next pour of concrete is placed against it. The resulting "cold" joint between the two pours becomes a weak point in the casting.
- When casting on site, do not place concrete when the temperature of the soil or formwork is below 10°C. Protect freshly cast concrete from freezing for a minimum of 7 days after placement. Use insulated tarps or plastic sheets covered with a thick layer of straw to contain the heat of the curing concrete and to protect the concrete from freezing. Ideally the concrete should not be cast if cold weather, below 5°C to 10°C, is forecast.
- Similarly, protect freshly cast concrete from high temperatures, direct sun, and high winds by covering the concrete with burlap and regularly wetting the burlap. Ensure the burlap is clean so as not to stain the concrete.

The exposed surfaces of concrete should be level and finished with a uniform brush finish.

Steel Reinforcement

Steel reinforcement should conform to CSA Standard A23.1, *Concrete Materials and Methods of Concrete Construction*. Reinforcement bars should be deformed bars. Welded wire fabric may also be used in some instance and should conform to CSA Standard G30.5, *Welded Steel Wire Fabric for Concrete Reinforcement*. Steel strands, tendons and cables may be used in pre-stressed concrete to fabricate multiple marker beam-on-grade and beam-on-pier type foundations, and should conform to CSA Standard G279, *Steel for Prestressed Concrete Tendons*.

The following are general recommendations for reinforcement:

- Reinforcement steel should be clean and free of mud, oil, and heavy rust deposits. Mild mill scale and surface corrosion on the reinforcing is acceptable.
- Reinforcement bars should be supported inside the formwork as required on pre-cast concrete block supports. The concrete blocks should be made of a concrete that is at least equal in quality to the concrete being placed for the footing. Do not use formed wire supports, broken bricks, or pieces of wood as supports for the reinforcement.

- Secure the reinforcement to the supports using plastic coated wire to prevent accidental slipping during placement of the concrete. Do not use plain un-coated wire.
- Reinforcement bars must always be provided with a minimum of 75mm (3") concrete cover on surfaces exposed to the soil.

Epoxy coated reinforcement bars can be used to increase the corrosion resistance of the steel, however, accidental cuts, scratches and nicks in the epoxy coating resulting from rough handling during delivery and installation can reduce the effectiveness of the coating and must be touched up with a brushed on epoxy. Similarly, the ends of the bars, where they have been cut, must also be field coated. Epoxy coated bars must be shop bent using proper tools and equipment so as not to shatter or crack the epoxy coating: bending the bars to too tight a curvature can damage the coating. Epoxy coated bars should never be field bent. Epoxy coated bars should meet the requirements of ASTM standard D3963, *Specification for Prefabricated Epoxy-Coated Reinforcing Steel Bars*.

A practical reinforcement alternative to steel or epoxy coated steel reinforcement is fibre-reinforced polymer reinforcement, in particular glass fibre reinforced polymer reinforcement (GFRP). This type of reinforcement does not corrode and is of particular benefit in beams where the 75mm concrete cover required for steel reinforcement is difficult to obtain. Also, based on testing by the University of Manitoba, GFRP is preferred for use as the dowels in the pinned connections used for upright markers, because of its strength, flexibility, and corrosion resistance.

Granite

Granite blocks used as foundation pads for flat and other form markers should be fabricated from Barre Gray Granite. When new blocks are being installed to support existing markers, the granite should match the granite of the existing marker.

The top and bottom sides of the granite blocks should be sawn to permit accurate seating of the block on the granular fill base and the marker on the block. The sides of the block may be sawn or cut in a suitable manner determined by the quarry or the local supplier. If the top of the granite base is intended to be exposed at the grave surface, it should be finished with neatly squared edges and a steeled finish.

Epoxy Adhesive

Epoxy Adhesive is used with the pinned connection method to bond the stainless steel or glass fibre dowels to the concrete foundation and granite marker. The epoxy should come pre-packaged in two-part mixing tubes to ensure proper mixing proportions. The epoxy must be appropriate for use in holes cored with diamond coring equipment, and must have a low sensitivity to use in wet or oversized holes. The epoxy should have a reasonably long working time, also referred to as its gel time, of up to thirty minutes to permit adjustment to the alignment of the markers, and should be fully cured within twelve hours at normal temperatures (10 degree Celsius or above).

The epoxy adhesive should match or exceed the following specifications for performance:

| | |
|----------------------|---|
| Standard | Type IV, grade III, class A, B, C except gel time as per ASTM C881 <i>Standard Specification for Epoxy-Resin Based Bonding Systems for Concrete</i> |
| Bond Strength | 12.4 MPa at 2 days per ASTM C882-91 <i>Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear</i> |
| Compressive Strength | 82.7 MPa as per ASTM D-695-96 <i>Standard Test Methods for Compressive Properties of Rigid Plastics</i> |
| Tensile Strength | 43.5 MPa at 7 days as per ASTM D638-97 <i>Standard Test Method for Tensile Properties of Plastics</i> |
| Elongation at break | 2.0% as per ASTM D-638-97 <i>Standard Test Method for Tensile Properties of Plastics</i> |
| Absorption | 0.06% as per ASTM D-570-95 <i>Standard Test Method for Water Absorption of Plastics</i> |

Epoxy mixing, placement, and curing procedure must follow the manufacturers' recommendations; however, the following general recommendations also apply:

- Use correct mixing nozzles and applicators, as recommended by the epoxy manufacturer.
- Clean holes with a brush and air prior to injecting epoxy. Cleaning dust from the holes is essential to the performance of the epoxy and most manufacturers supply air nozzles and hand pumps specifically designed to clean holes out.
- Twist the dowels while inserting them into the epoxy filled hole.
- After making adjustments for alignment, do not disturb the anchor or marker prior to completion of the full cure time.

Glass Fibre Reinforced Polymer (GFRP) Rod

Glass Fibre Reinforced Polymer (GFRP) rods are recommended for use as the dowels connecting the granite marker to the concrete foundation in the pinned connection method. The rods must be glass fibre reinforced polymer bars with a sandy coating on their surface to aid in bond development. GFRP rods must conform with the standards

outlined in CAN/CSA-S806-02, *Design and Construction of Building Components with Fibre Reinforced Polymers*. Material specifications for the rods must match the following:

| | |
|--------------------------------------|--|
| Bar diameter | 16mm (5/8") |
| Binding material | Modified vinyl ester, volume fraction 25% |
| Fibre reinforcement | Continuous E-glass fibres, volume fraction 75% |
| Ultimate Tensile Strength, F_u | 674 MPa |
| Tensile Modulus of Elasticity, E_t | 42000 MPa |

Follow the manufacturer's recommendations for handling, storing, cutting and placing GFRP rods.

Stainless Steel Threaded Rod

Stainless Steel threaded rods are acceptable for use as the dowels connecting the granite marker to the concrete foundation in the pinned connection method, though GFRP rods are preferred. The rods must be AISI 316 stainless steel rods, threaded to aid in bond development. Material specifications for the rods must match the following:

| | |
|--------------|-------------|
| Bar diameter | 16mm (5/8") |
|--------------|-------------|

Follow the manufacturers recommendations for handling, storing, cutting and placing stainless steel rods.

Cementitious Grout

Cementitious grout is used with the grouted in pocket and grouted between bumper connection methods to bond the granite marker in the pocket or between the bumpers. The grout should be a pre-blended cementitious mixture requiring the addition of only water to ensure ease of mixing on site. The grout must be concrete coloured, non-shrinking, non-metallic, non-corrosive and must not contain chlorides. The grout should also only develop low levels of heat when curing.

The grout should match or exceed the following specifications for performance:

| | |
|----------------------|---|
| Compressive Strength | 35 MPa at 28 days as per CSA A23.2-1B <i>Methods of Test for Concrete</i> |
| Flow Cone | 25-30 sec as per CSA A23.2-1B <i>Methods of Test for Concrete</i> |

| | |
|-------------------|---|
| Aggregate Grading | 100% passing 2.5mm as per ASTM C136 <i>Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates</i> |
| Durability Factor | 101 as per ASTM C666 (Procedure A) <i>Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing</i> |

In installations where water soluble sulphates (SO_4) in the soil measure greater than 0.2 %, or sulphates in ground water measure greater than 1500 mg/litre; ensure that the grout is also sulphate resistant.

Grout mixing, placement, and curing procedures must follow the manufacturers recommendations, however, the following general recommendations also apply:

- Remove all grease, oil, ice, snow, or other foreign deposits from the surfaces into which the grout will come into contact.
- Roughen the concrete surfaces to which the grout will bond, remove all dust and loose particles using a brush or oil-free compressed air.
- Keep the concrete surfaces with which the grout will come into contact wet for a several hours before grouting. Surfaces must be saturated surface dry (surface will not absorb any more moisture) at the time of grouting. Remove any standing water before grouting.
- Apply a slurry of grout to the concrete surfaces with which it is intended to bond (i.e. inside faces of pocket and bumpers). A slurry is a very liquid mixture of the grout, made by adding additional water to the grout mixture.
- Grout should be used within one hour of mixing, discard any grout which has not been used within this time in an appropriate manner.
- Moist cure the grout, starting immediately after placement and finishing, in accordance with manufacturers instructions. Typical curing methods include misted water, damp burlap, and white polyethylene film. Protect freshly placed grout from direct sunlight, wind, rain and frost.
- Protect grout from freezing for a minimum of 72 hours after placement.

Granular Fill

Granular fill used for drainage purposes beside and below the foundation pads and beams should be a granular material composed of inert, hard, durable crushed stone or gravel. The fill should be screened of fine particles and free of organic material, and clay and silt balls.

Two gradations of granular fill are required depending on the depth of the fill: base course and sub-base course. The base course and sub-base course material should fall within the gradations outlined in Table 4.4a, below and determined in accordance with ASTM C136 *Method for Sieve Analysis of Fine and Coarse Aggregates*.

| Table 4.4a | Recommended Gradation of Base Course and Sub-base Course Granular Fill | |
|------------|--|--|
| | Passing Standard Sieve | Gradation Limits (Percent passing by weight) |
| | | Base course granular Sub-base granular |
| | 75 mm | 100 |
| | 25 mm | 100 50-85 |
| | 19 mm | 80-100 |
| | 9.5 mm | 50-100 |
| | 4.75 mm | 40-70 |
| | 2.36 mm | 25-50 |
| | 1.18 mm | 15-35 |
| | 0.3 mm | 5-20 |
| | 0.15 mm | 0-16 |
| | 425 µm | 0-5 |
| | 75 µm | 0-5 |

The thickness of the layers of granular material placed beneath the foundation will vary depending on the soil type present. Table 4.4b, below details the thickness of the fill and compaction recommendation for each common soil type.

The granular material should be placed in maximum 150mm (6") deep layers, and each layer should be compacted prior to the placement of subsequent layers. Layers compacted with vibrating plate compactors, or similar, should be compacted to 95% standard proctor density.

| Table 4.4b | Recommended Thickness Of New Granular Fill By Soil Type | |
|---|--|---|
| Soil Type | Recommended Thickness of New Granular Fill | |
| | Single Marker Foundations | Multiple Marker Beam-on-Grade Foundations |
| Reasonably free draining coarse granular soil (i.e. gravelly soil), including glacial till. | No new granular fill is required beyond that necessary for leveling purposes. | Minimum 100mm (4") base course compacted by vibrating plate or similar, for leveling purposes. |
| Reasonably free draining sandy soil with no ongoing soil movement problems. | Minimum 150mm (6") base course compacted by hand. | Minimum 200mm (8") base course compacted by vibrating plate or similar. |
| Organic soils (including peat and organic silts), clays, and fills with ongoing soil movement problems. | Minimum 250mm (10") compacted by vibrating plate or similar. Base course 4" thick, sub-base course 8" thick. | Minimum 400mm (16") compacted by vibrating plate or similar. Base course 4" thick, sub-base course 12" thick. |

Geotextile Filter Fabric

The granular fill should always be wrapped with a geotextile filter fabric to prevent it from becoming clogged with fine soil particles transported by water movements. The geotextile should be a non-woven synthetic fabric with a filtering opening size (FOS) of 75 to 150 micrometers. Any joints in the fabric should be overlapped by a minimum of 200mm (8").

4.4.3 Marker / Foundation Connections

Three methods of connecting grave markers to their foundations are presented in this section: pinned, grouted in pocket, and grouted between bumpers. The following presents details on the fabrication and installation procedures recommended for each connection method. A brief discussion is also presented on connections between flat and special order markers, and their foundations.

Pinned Connection for Upright and Special Order Markers

The pinned connection method is the preferred method for all upright marker to foundation connections. The pinned connection method uses two GFRP or stainless steel dowels to connect the granite marker to the concrete foundation. Epoxy adhesive bonds the dowels to the marker and the foundation. Holes, into which the dowels are epoxied,

must be drilled into the base of the granite marker and top of the concrete foundation. Some special order markers, notably the taller wedge markers, also require the marker to be fixed to the foundation base, and the pinned connection type should again be used in these situations. Another less common special order marker is one that involves the use of upright markers that are connected to exposed granite bases, which in turn sit on multiple marker beam type foundations. This emplacement method is used in some cemeteries when the marker is located in civilian areas, and cemetery regulations forbid attaching the markers to the foundations. These markers should use the pinned connection to connect the marker to its granite base.

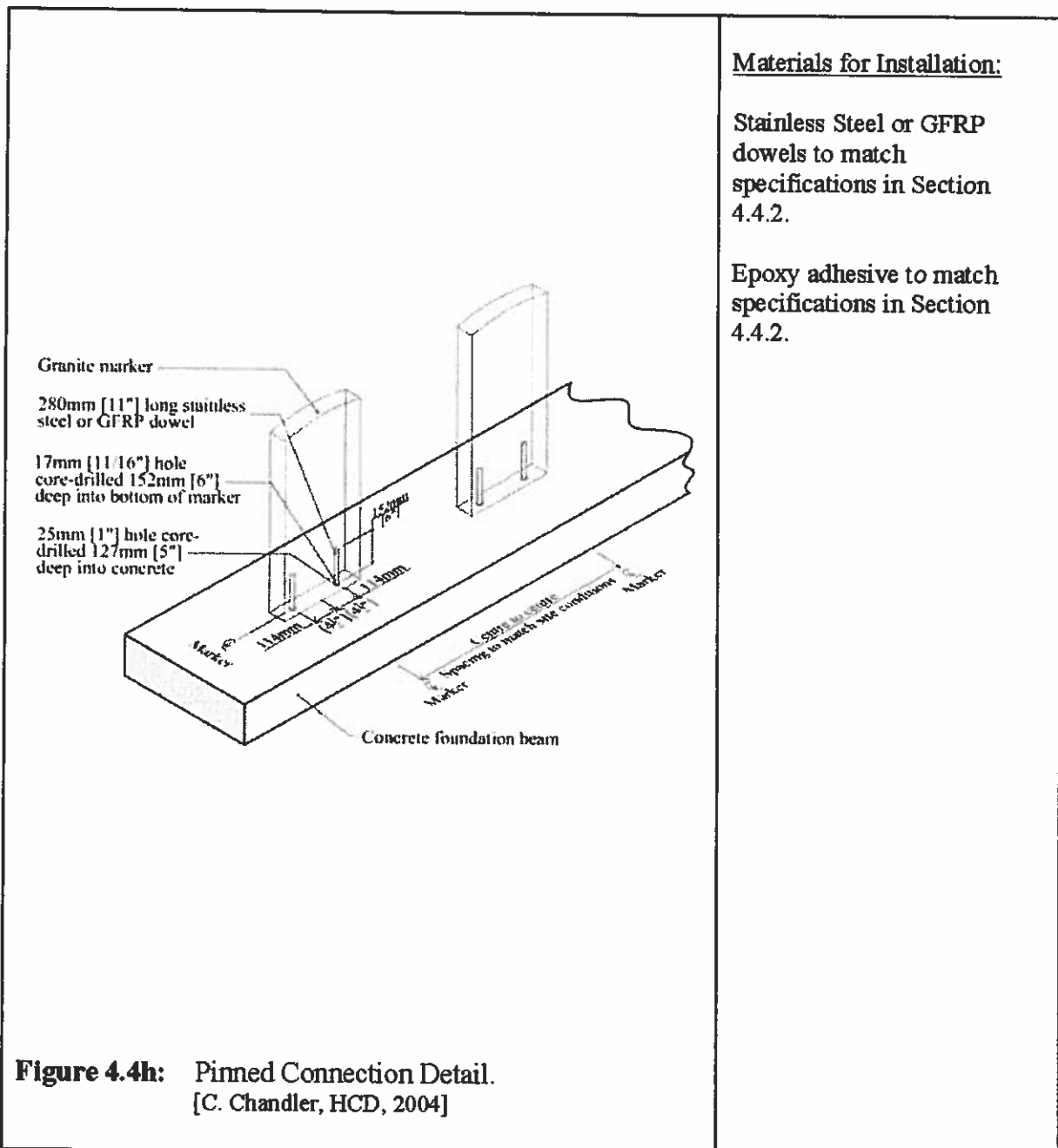
Figure 4.4h, below, illustrates the pinned connection detail for connecting an upright marker to its concrete foundation and the recommended installation process. The details and procedures are similar when using this connection detail for other markers types.

The following steps are required to complete the installation of a marker using the pinned connection method. Steps 2 and 3 can typically be completed at the memorial contractors workshop, as well as steps 4 and 5 for single marker foundations. The other steps are completed on site at the cemetery:

1. Cast and install the foundation pad or beam following the recommendations for new installations. Ensure that none of the steel reinforcement in the foundation passes through the middle of the foundation where the holes for the dowels will be core-drilled.
2. Using a template to ensure accuracy, core-drill holes in the bottom of the granite marker. Ensure the holes are straight into the marker and do not tilt towards one face of the marker. Use a diamond-coring bit sized slightly larger than the diameter of the dowel, and note that the sand coating on the GFRP dowels increases their actual diameter closer to 17.5 mm (11/16"). Core drill the holes 150 mm (6") deep, do not over-drill the depth. Clean the holes of all dust or excess water using oil free compressed air.
3. Inject epoxy into the holes and insert the dowel, twisting it as it is being pushed into the hole. Inject only enough epoxy to fill the hole when the dowel is completely inserted (the actual quantity will vary depending on the depth of the hole and will become more apparent after a few installations). Partially withdraw the dowel to check that full coverage with the epoxy has been achieved. Clean off any epoxy that oozes from the hole taking care to keep it off of the faces of the marker. Allow the epoxy to fully cure before moving the marker.
4. Using a template to ensure accuracy, core-drill holes into the foundation pad or beam. Ensure the holes are plumb by using a bubble level or similar to check the angle of the drill while drilling. Use a 25mm (1") diameter diamond core drill. Drill the holes 150mm (6") deep, over-drill the depth of the hole slightly if necessary to ensure that the dowel does not bottom out when the marker is set on

the foundation (measure the depth of the hole and compare with length of exposed dowel protruding from the marker). Clean the holes of all dust or excess water using oil free compressed air.

5. Fill holes in foundation one half to two thirds full of epoxy (the actual quantity will vary depending on the depth of the hole and will become more apparent after a few installations). Carefully and slowly lower the marker onto the foundation. After the marker is fully seated on the foundation, temporarily lift the marker several inches and check to see that the epoxy in the holes has filled the hole to the top. Add more epoxy as required to fill the hole when the marker is fully seated, and re-lower the marker.
6. Check marker alignment and use small wood shims to level and align the marker. Complete all adjustments within the gel time of the epoxy. Clean any epoxy that may have oozed out from beneath the marker if this is an exposed foundation emplacement. Use lacquer thinner to clean the epoxy.
7. Allow the epoxy to fully cure before removing shims and backfilling topsoil around marker.



Grouted-in-Pocket Connection for Upright Markers

The grouted-in-pocket connection type is acceptable for use with upright markers when installing a new marker on an existing foundation beam with pre-existing pockets cast for this type of connection. New installations on new foundations should utilize the pinned connection method, which allows for a uniform depth of soil over top of the beam.

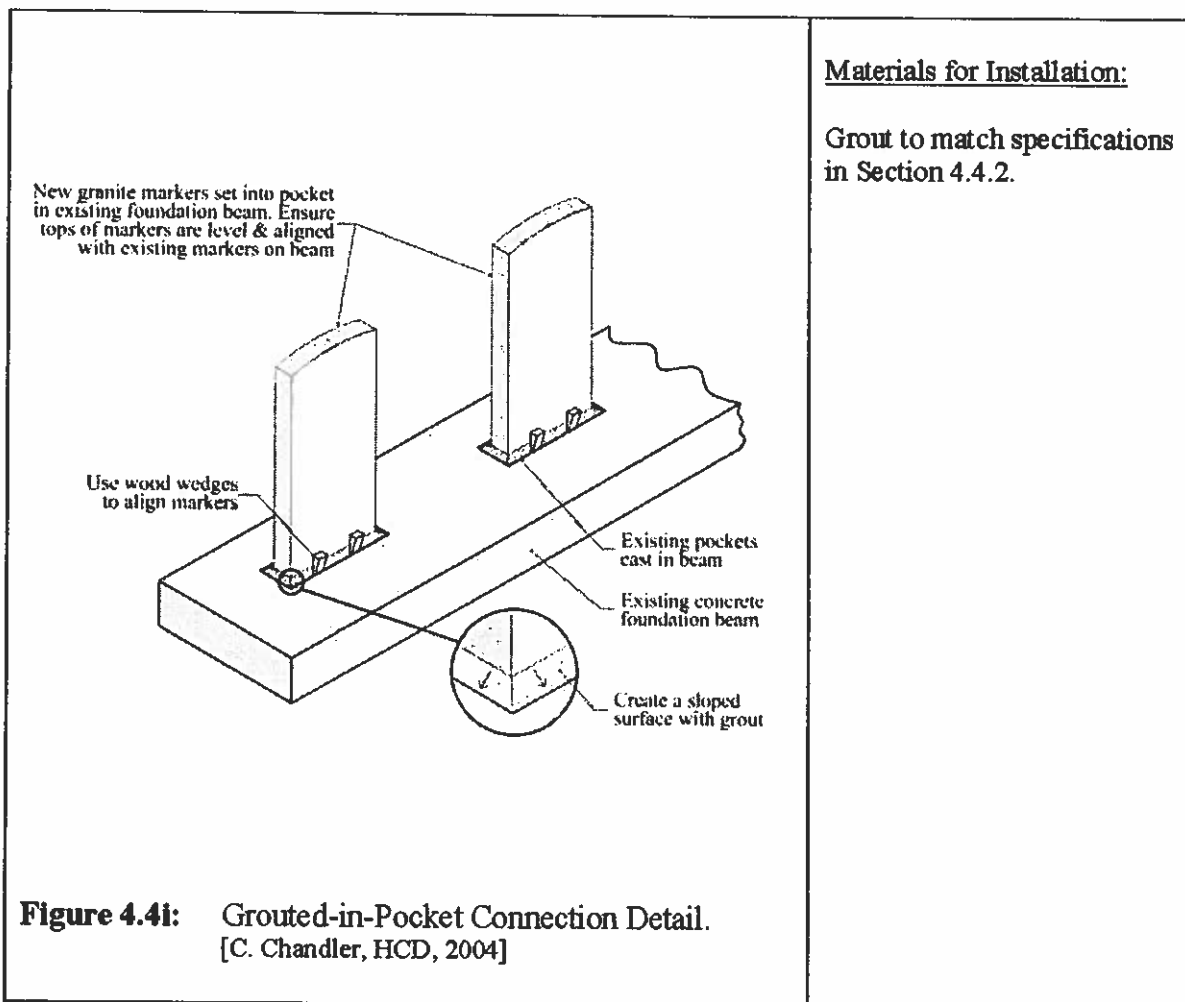
The grouted-in-pocket connection involves setting the marker in a roughly 100 mm (4") wide x 400 mm (16") long pocket previously cast into the middle of a multiple marker

foundation beam. The actual dimensions of the pocket may vary, and in some cases, a trough is cast along the entire length of the beam, instead of individual pockets.

Figure 4.4i, below, illustrates the pocket connection installation process for fastening a marker using this type of connection.

The following steps are required to complete the installation of a marker using the grouted-in-pocket connection. All of the following steps will be completed at the cemetery:

1. If necessary, excavate and expose the existing beam foundation and pocket. Clean the pocket of all soil and debris. If the pocket has been temporarily grouted full, remove the grout using small pneumatic or electric chipping hammers. Place and align the new marker in the pocket. Fill the bottom of the pocket with crushed stone to a depth required to suit the height of the marker.
2. Use wooden wedges to adjust the alignment of the marker to match the markers previously installed on the same foundation beam, four wedges should be sufficient. The wooden wedges should be soaked in water prior to use.
3. Prior to placing the grout, wet the inside of the pocket and the faces of the granite marker with a misting of water over a period of several hours or until the surfaces stay damp. Grout the marker into place using the grout mix and placement procedures recommended by the grout manufacturer and above. Take care not to smear or spill the grout on the face of the marker or on the foundation around the pocket. Clean any spills or smears immediately using water and a soft bristle brush.
4. Ensure that the grout joint is proud of the concrete and is sloped from the marker down to the concrete as shown in Figure 4.4j. The grout joint should have a smooth finish matching that of the concrete.
5. Cure the grout following the grout manufacturers recommended procedures. Once the grout has set to a sufficient strength to support the marker, remove the wooden wedges, and fill the remaining joint openings with additional grout. Cure the grout following the grout manufacturers' recommended procedures.
6. If the existing beam is buried, ensure the grout is fully cured before backfilling topsoil around marker.



Grouted-Between-Bumpers Connection for Upright Markers

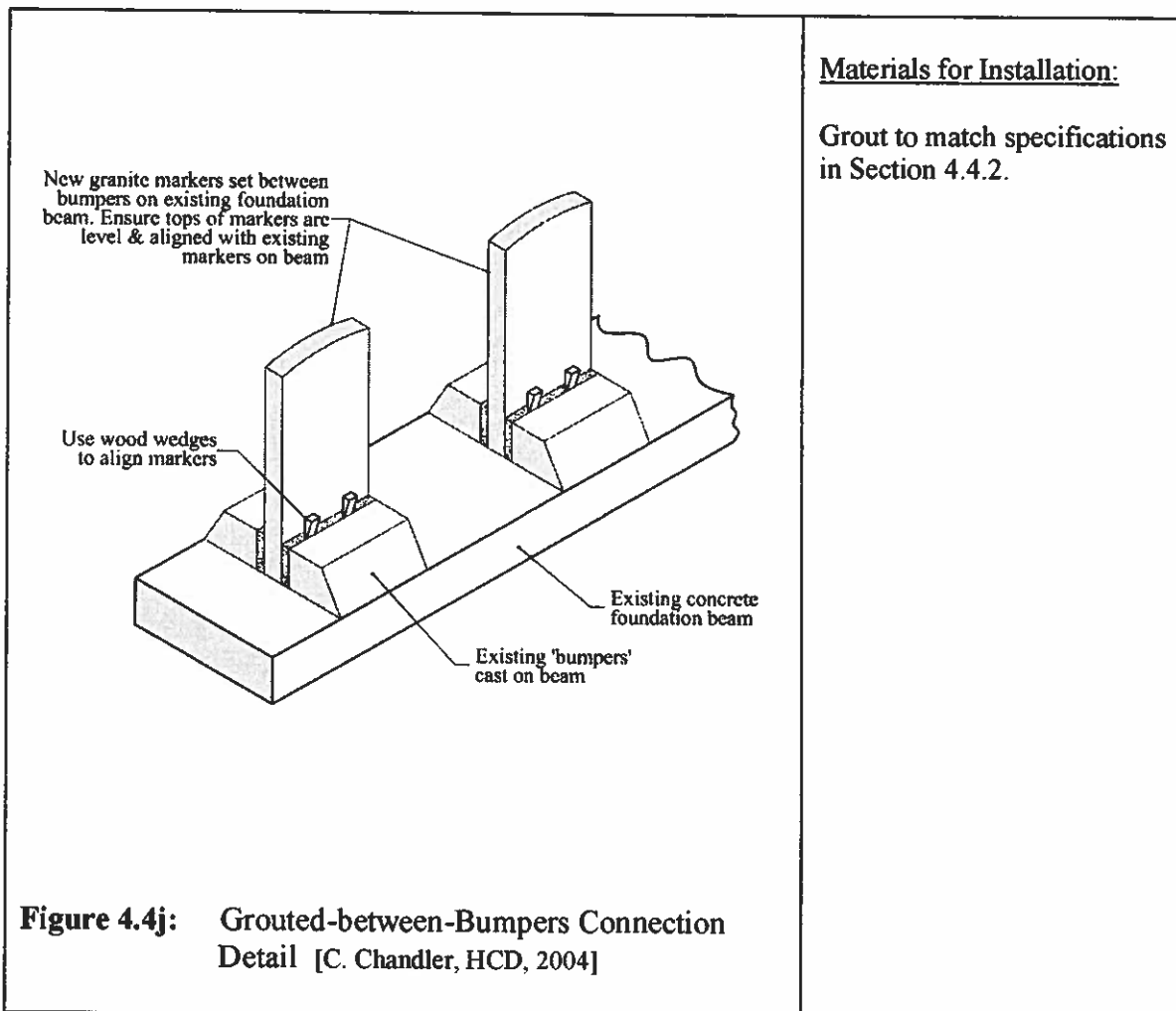
The grouted-between-bumpers connection type is acceptable for use with upright markers when installing a new marker on an existing buried foundation installation with pre-existing bumpers. New installations on new foundations should utilize the pinned connection method.

The grouted-between-bumpers connection involves setting the marker between concrete “bumpers” that have been cast on the top side of the multiple marker foundation beam, and grouting the marker in between these bumpers.

Figure 4.4j, below, illustrates the installation process for fastening a marker using this type of connection.

The following steps are recommended to complete the installation of a marker using the grouted-between-bumpers connection. All of the following steps are completed at the cemetery:

1. Excavate and expose the existing beam foundation and bumper. Clean the area between the bumpers of all soil and debris. Erect and align the marker in between the bumpers. Use wood shims at the base of the marker to align its height with adjacent markers
2. Use wooden wedges to adjust the alignment of the marker to match the markers previously installed on the same foundation beam, four wedges should be sufficient. The wood wedges should be soaked in water prior to use.
3. Prior to placing the grout, wet the bumpers and the faces of the granite marker with a misting of water over a period of several hours or until the surfaces stay damp. Grout the marker into place using the grout mix and placement procedures recommended by the grout manufacturer, and above.
4. Take care not to smear or spill the grout on the face of the marker where it will be visible after burial of the foundation. Clean any spills or smears immediately using water and a soft bristle brush.
5. Ensure that the grout joint is proud of the concrete and is sloped from the marker down to the concrete as shown in Figure 4.4h.
6. Cure the grout following the grout manufacturers recommended procedures. Once the grout has set to a sufficient strength to support the marker, remove the wooden wedges and fill the remaining joint openings with additional grout. Again cure the grout following the grout manufacturers' recommended procedures.
7. Ensure the grout is fully cured before backfilling topsoil around marker.



Connections for Flat, Bronze, Pillow and Scroll Markers

Flat, bronze, pillow, and scroll type markers should not be mechanically anchored to their foundations in any way. Fixing these markers will subject them to a greater risk of damage in the event of an accidental impact with a lawn mower or other maintenance equipment. Where vandalism is a concern, however, some light attachment may be appropriate. In the case of buried emplacements, a bed of mortar placed between the marker and its foundation will help hold the marker in place. In the case of exposed foundation emplacements, the markers can be adhered to the foundation with dabs of silicone sealant. It is very important to only use dabs of sealant and not continuous beads or lines, so as not to inadvertently trap moisture between the marker and its foundation.

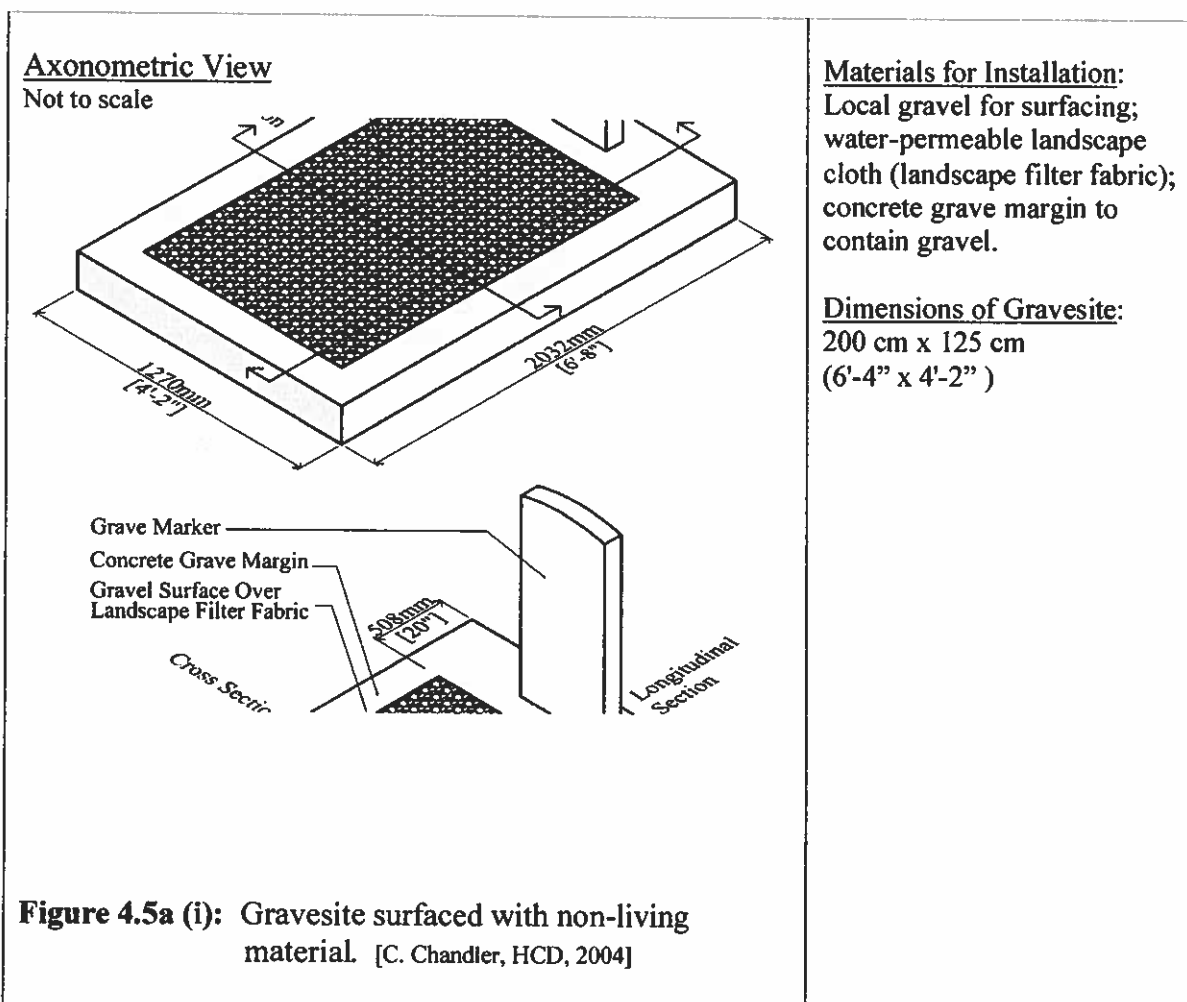
Note that in the case of bronze markers, the connection in question is between the granite base on which the bronze plaque is mounted and the granite or concrete foundation on which this base rests. The bronze plaque must be appropriately fixed to its granite base as detailed in Section 4.1.4.

4.5 Grave Surfaces

While mown grass is the most common surface material for veterans' gravesites in Canada, it is not a practical material for installation in all parts of the country. Cemeteries subjected to extreme cold, on-going drought, or substantial salt accumulation due to ocean spray may not be able to keep grass alive over several years with a reasonable amount of maintenance effort. Therefore, this section will provide standards for surfacing veterans' gravesites with non-living material, as well as with turfgrass. It will also discuss the conditions that need to be in place before other plant material can be considered for installation, and why the use of other plant material is not recommended at this time.

4.5.1 Non-Living Surface Materials

This recommended standard for gravesites surfaced with local gravel is derived from existing practices in Churchill, Manitoba and parts of Newfoundland and Labrador where grass is not easily grown.



Cross-Section Through Grave

Not to scale

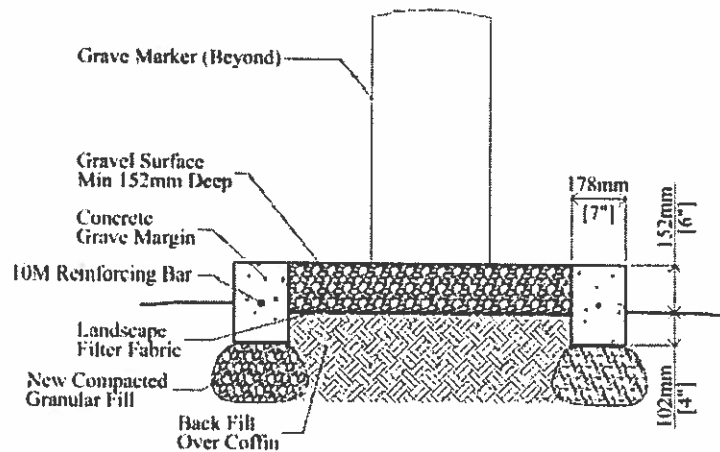


Figure 4.5a (ii): Cross-section detail of gravesite surfaced with non-living material
[C. Chandler, HCD, 2004]

Materials for Installation:

New granular fill beneath concrete curb. For depth of fill and compaction requirements refer to **Section 4.4.2**. Treat curb as a single marker foundation.

New concrete curb. Refer to **Section 4.4.2** for recommended concrete mix design and forming and curing requirements.

New reinforcing. Refer to **Section 4.4.2** for reinforcing specifications and placement requirements.

Longitudinal-Section Through Grave

Not to scale

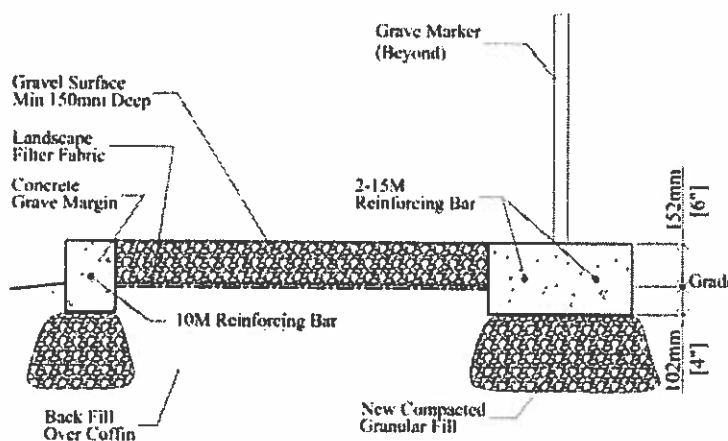


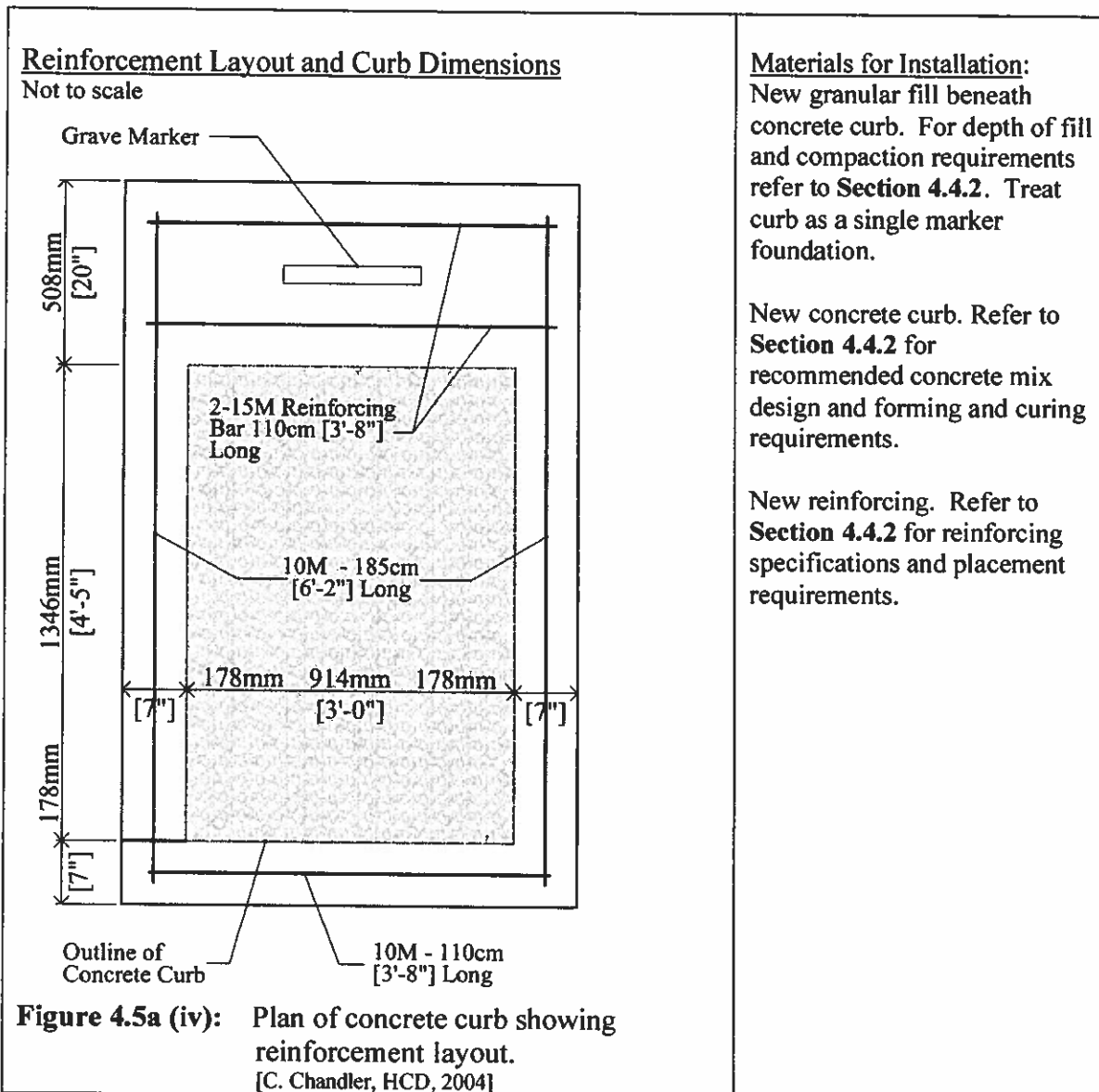
Figure 4.5a (iii): Longitudinal-section detail of gravesite surfaced with non-living material
[C. Chandler, HCD, 2004]

Materials for Installation:

New granular fill beneath concrete curb. For depth of fill and compaction requirements refer to **Section 4.4.2**. Treat curb as a single marker foundation.

New concrete curb. Refer to **Section 4.4.2** for recommended concrete mix design and forming and curing requirements.

New reinforcing. Refer to **Section 4.4.2** for reinforcing specifications and placement requirements.



4.5.2 Turfgrass

Mown turfgrass is the most common grave surfacing material in Canada. While turfgrass in most cemeteries with veterans' gravesites is already well established, a number of grass mixtures can be recommended for areas that need renovation. These mixtures are applicable to either seed or sod.

The recommendations for grass mixtures use the Plant Hardiness Zones developed by Natural Resources Canada and Agriculture and Agri-Food Canada using average climatic data (such as minimum winter temperature, length of frost-free period, summer rainfall, maximum temperature, snow cover, and elevation) to predict plant survival. Plant Hardiness Zones are numbered with the letters 'a' or 'b' attached to the number. The zones range in Canada from 0a, the coldest zone, to 8a, the warmest zone. A zone with

'a' appended to its number is colder than the zone of the same number with 'b' appended. To give some sense of the Plant Hardiness Zones, Vancouver is located in zone 7a, Winnipeg in 2b, Toronto in 5b, Quebec City in 4b, and St. John's in 5a.

Maps of the Plant Hardiness Zones in Canada are available from Natural Resources Canada or Agriculture and Agri-Food Canada. All gravesite inspectors should know the Plant Hardiness Zones for the cemeteries they cover.

| Table 4.5a | | |
|----------------------|------------------|---|
| Plant Hardiness Zone | Other Conditions | Grass Mix |
| Zones 1a to 2a | Sunny | 50% Kentucky bluegrass (<i>Poa pratensis</i>) 40% creeping red fescue (<i>Festuca rubra rubra</i>) 10% annual ryegrass (<i>Lolium multiflorum</i>) Note: Annual ryegrass serves as a nurse crop for the first year until other grasses are established. |
| Zones 2b to 5b | Sunny | 60% Kentucky bluegrass (<i>Poa pratensis</i>) 30% creeping red fescue (<i>Festuca rubra rubra</i>) 10% perennial ryegrass (<i>Lolium perenne</i>) |
| Zones 2b to 5b | Shade | 70% creeping red fescue (<i>Festuca rubra rubra</i>) 20% Kentucky bluegrass (<i>Poa pratensis</i>) 10% perennial ryegrass (<i>Lolium perenne</i>) |
| Zones 6a to 8a | Sunny | 60% perennial ryegrass (<i>Lolium perenne</i>) 30% creeping red fescue (<i>Festuca rubra rubra</i>) 10% Kentucky bluegrass (<i>Poa pratensis</i>) |
| Zones 6a to 8a | Shade | 70% chewing fescue (<i>Festuca rubra commutata</i>) 30% perennial ryegrass (<i>Lolium perenne</i>) |

To determine the need for nutrients and pH amendments to grow healthy turfgrass, the soil should be tested once every five years. Results of the soil test will determine the type and amounts of fertilizer to increase soil fertility, as well as any need to add lime or sulphur to bring the soil pH into the range that supports the growth of turfgrass.

4.5.3 Other Plant Material

CWGC cemeteries in northern Europe and other parts of the world have mixed plantings of perennials, alpine and floribunda roses immediately adjacent to the grave markers. The initial concept for this grave surface treatment, developed toward the end of the First World War, was to make an association between the gardens of Great Britain and the foreign fields in which the soldiers are now buried.

At the beginning of this project, VAC managers familiar with the CWGC cemeteries in Europe, asked the HCD team to provide list of plants suitable for veterans' gravesites within Canada. After reviewing the situation in Canada and the CWGC maintenance

regime in Europe, HCD has come to the conclusion that gravesite surface treatments involving plant material other than turfgrass should not be recommended for veterans' graves managed by VAC.

The reasons for this recommendation are as follows:

1. To provide planting beds at only some gravesites, and not others, would contradict the principle that all veterans are to be treated with equal dignity in death. Therefore the scale of such a project would be immense.
2. The degree of horticultural expertise required to maintain mixed borders in good order exceeds the capacity of most cemetery maintenance personnel in this country.
3. Contracting to the private sector for the care of planting beds at all veterans' gravesites would be extremely expensive given the numbers of burials. Furthermore, the landscape maintenance industry in Canada is also not geared to the care of mixed borders.
4. If VAC were to take on the task of caring for planting beds at veterans' gravesites by starting a landscape maintenance program in Canada similar to that run by the CWGC in Europe, it would require a minimum of two thousand horticultural workers with equipment and transportation supplied by Canadian taxpayers.
5. Most of Canada is subjected to drought through July and August. This would mean that planting beds would require regular watering during those two months. This watering will increase the build-up of biotic growth on the grave markers, and will increase the need for cleaning in order to ensure that inscriptions remain legible.
6. In order to be visible within the mixed planting beds, all existing flat granite markers would have to be raised and placed on foundations so that they would no longer be flush with the ground surface.