Toitu te Land whenua Information New Zealand

Specifications for Geodetic Physical Network

Version 2.6

National Geodetic Office

24 November 2010

Contents

Foreword

Section 3(c) of the Cadastral Survey Act 2002 defines a purpose of the Act to:

> *provide for a national geodetic system and a national survey control system to be maintained.*

These specifications form part of a set of specifications developed by the National Geodetic Office, Land Information New Zealand, to contribute to achieving this purpose. They relate to the provision of geodetic control maintenance to support the geodetic programme as required by the Cadastral Survey Act 2002 sec 7(1)(a) and (b). This specification is a major revision of the previous Geodetic Physical Network specification, version 1.13 published in November 2006.

Related Standards, Specifications

- Standard for tiers, classes and orders of LINZ data – LINZS25006 (21 September 2009)
- Standard for the New Zealand survey control system – LINZS25003 (21 September 2009)
- Guideline for the provision and maintenance of the New Zealand survey control system – LINZG25704 (21 September 2009)
- Specifications for Geodetic Control Survey Version 2.5: National Geodetic Office 2010
- Specifications for Post-Earthquake Precise Levelling and GNSS Survey Version 1.0: National Geodetic Office 2010
- Specifications for Geodetic Contract Deliverables Version 1.5: National Geodetic Office 2010
- Rules for Cadastral Survey 2010 - LINZS65000 (24 May 2010)

Version 2.0	**Released 31 July 2007**
Version 2.1	Section 1 “Introduction” simplified to remove references to separate geodetic networks.
Version 2.2	Minor updates to section 1.3, 4.2.4, and 4.2.6
Version 2.3	Section 1.3. Update photo requirements. Section 3. Additional section added on preserving a mark and section 3.10 amended. Section 4. New section added on trig station information plates
Version 2.4	Section 1.4. New section added giving details of where specialist

	maintenance items can be obtained
Version 2.5	This document is now prepared and maintained by the National Geodetic Office, Land Information New Zealand. Section 1.1. Additional requirement to inform landowner/occupier of site visit Section 2.1. Revised site selection criteria Section 2.2. Revised site maintenance requirements Section 3.2. Change in requirements for the installation of identification plaques Section 3.3.1. Additional section outlining 5th order mark requirements Section 3.5. Additional paragraph referring to large diameter tubes. Section 3.10 New service of Offsetting of an Existing Low Order Geodetic Mark Section 4.3.1 Additional section outlining specifications for Repairs for Safety. Section 5 Additional section added outlining specifications for Inventory Service
Version 2.6	Section 1.3 Clarified requirements for after photos Section 3.2 Clarified circumstances in which an ID plaque should be installed Section 3.3.3 New section outlining requirements for new precise-levelling benchmarks Section 5 Added requirement to capture NZGD2000 coordinates for low-order marks

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SPECIFICATIONS FOR GEODETIC PHYSICAL NETWORK

1 Introduction

This specification covers the provision of the physical network and maintenance requirements for the New Zealand Geodetic Datum 2000 (NZGD2000) geodetic marks. The survey requirements for the networks are covered in the Specifications for Geodetic Control Survey.

1.1 *Permission to Access a Site*

Permission to enter private land should be obtained from the landowner/occupier prior to any access to the site. If after reasonable attempts, the landowner/occupier is unable to be contacted prior to the work commencing, the contractor is required to leave their contact details so that the landowner/occupier is informed of the site access. Details of the land owner/occupier may be available on the Report of Maintenance Work Completed or Required report supplied by the National Geodetic Office or the Geodetic Database. Any maintenance work undertaken on the site, mark, beacon and other protection structure, including site and vegetation clearance, should be done in consultation with the landowner/occupier.

Contractors must be fully aware of their responsibilities and obligations under the Health and Safety in Employment Act 1992. Sites, marks, beacons and other protection structures shall be left in a respectable and safe state.

1.2 *Notification of Work Being Undertaken*

The National Geodetic Office shall be notified of any work that is likely to affect users of the site, mark and/or beacon being maintained during the course of the work, e.g. beacon removal for a period while repairs are carried out.

Note: If a beacon is removed from a mark it should be laid on its side to avoid possible confusion if observed to while removed from its correct position.

1.3 *Before and After Photographs*

For each site visited and/or maintained photographs are to be taken of the mark and site prior to commencement of any maintenance work and again upon completion of any maintenance work. These photos must clearly show the work undertaken.

The following photos are required after maintenance work has been completed:

a) A Mark Photo. This must clearly show the mark and the material in which it is installed. It must show any maintenance carried out on the mark.

b) A Site Photo. This must clearly show the mark in relation to its immediate surroundings, including any protection structures. It must show any maintenance carried out on the site.

c) An Extended Site Photo. This must show a wider view of the site and its surroundings, including features which may help to locate the mark in the future. It must also contain enough information to convey the suitability of the mark for terrestrial or GNSS observations. Where the mark would not otherwise be clearly visible in the photo, an item (such as a road cone) should be placed over the mark to identify its location.

In all photos, care must be taken not to include members of the public, or anything else that could compromise an individual's privacy, bearing in mind that the photograph will be made available over the internet in a public database.

1.4 *Obtaining Specialist Maintenance Items*

If unable to be supplied by the Contractor, any LINZ-specific maintenance items (such as beacons and cast iron covers) may be obtained from the following supplier:

Mark Dunnett
Survey Services Hawkes Bay Ltd
PO Box 3028
NAPIER

Ph: 06 844 4354
Fax: 06 844 4346
Email: mark@surveyhb.co.nz

2 Geodetic Mark Sites

2.1 *Selection Criteria for a New Site*

When selecting a new geodetic mark site the Contractor shall carefully consider and report on the following criteria:

1. **Site Suitability**: Marks shall be sited in a manner so that they can be easily located and occupied.

2. **Site Permanence**: Care must be taken to ensure the permanence and continued availability of sites for at least 50 years. The permanence of the proposed mark is to be assessed with regards to the location of utilities above and below ground level and, where appropriate, in consultation with Local Authorities and Service Agencies.

3. **Site Stability:** The Contractor shall confirm by inspection that the mark is stable both as to structure and surrounding ground. A mark is considered stable if, in the course of normal survey activities, it cannot be moved by more that 5mm. Each site shall be assessed taking into account the:
   - order of the geodetic survey mark;
   - soil or rock type in which it is to be constructed ;
   - ground slope;
   - impact of possible vegetation growth;
   - development possibilities of the surrounding area;
   - physical form of the mark itself.

4. **Access:** Each site selected shall have unrestricted access unless otherwise agreed by the National Geodetic Office.

5. **Safety of Site**: Sites should be selected considering the practicality and safety of occupying the site and the safety to the public of an unoccupied site. Factors to be considered are proximity to vehicular traffic and other known and potential hazards. Marks in live traffic lanes are never appropriate.

The following criteria shall apply only where practicable:

6. **Sky Visibility**: Each mark shall have at least 80% clear visibility above 15 degrees and ideally be clear of obstructions above 10 degrees elevation. The impact of possible vegetation growth around the site and on the horizon shall also be taken into account.

7. **Presence of Obstacles**: Each mark should be at least 20 m (and preferably 50 m) clear of obstacles such as fences, buildings, and radio masts that may cause multipath problems.

8. **Usability of Site**: It is desirable that marks have inter-visibility to at least two other geodetic marks sufficient to allow practical application by those using conventional survey.

2.2 *Site Maintenance*

Access to and the area surrounding a mark shall be cleared to facilitate the safe and efficient use of that mark. If the mark is beaconed, vegetation shall be cleared so that it can be clearly viewed from the surrounding area. Consultation with the land owner/occupier is required prior to any site clearance being carried out.

The following work shall be undertaken:

1. **Clear Tall Plants**: Ideally all tall plants (including trees) shall be cleared from the site so that it is clear of all obstructions that may restrict visibility both to and from the site.

2. **Clear Vegetation**: All scrub like vegetation which impedes access or usability of a proposed or existing site, shall be cleared from within a one metre radius of the site and its protection structure

3. **Spray Vegetation**: Vegetation such as blackberry, gorse and grass (if not farmland) shall be sprayed within a one metre radius of a proposed or existing mark position and its protection structure so that regrowth is impeded.

2.3 *Disposal of Unwanted Material*

Any beacons, protection structures or parts thereof that have been replaced are to be removed from sites and disposed of in an environmentally friendly manner. Other debris such as cleared plants and vegetation and excavated material that cannot be left in a safe and tidy manner on or near the site (such as in urban areas) must also be removed and disposed of in an environmentally friendly manner.

3 Ground Marking

The appearance of a mark and its site shall be tidy and the work carried out to a professional standard.

3.1 *Mark Stability*

The permanence, stability, and resistance to damage of geodetic survey marks shall reflect their geodetic network purpose and order of mark. Whether a mark is new or existing, the requirements for permanence and stability are the same as detailed in Section 2.1.

3.2 *Identification Plaques*

Bronze identification plaques engraved to clearly show the mark's four-character geodetic code shall be installed:

- For all 4th order and higher NZGD2000 marks
- For all 3rd order and higher NZGD1949 marks

If the mark is in an urban area and is flush with its surround such as a footpath and has no protective cast iron cover, then an identification plaque need not be placed.

Note that any non-conforming plaques shall be removed only if their removal will not damage or disturb the mark.

The plaque shall be firmly secured to a concrete collar around the mark, to a stable rock or permanent structure in close proximity (i.e. within 0.5m) to the mark, so as to render it difficult to remove.

The plaque shall be cast in the form shown in Fig 1 with outside base dimension of 112mm by 63mm. The wording shall conform to that shown in Fig 1.

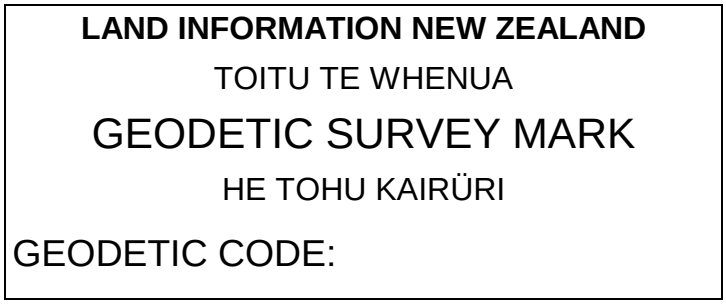

Figure 1: Identification Bronze Plaque

3.3 *Establishing a New Ground Mark*

New ground marks shall conform to the following specifications:

3.3.1 *5th order marks*

All new 5th order marks must be a bronze (mushroom) plaque unless it is unreasonable to do so, in which case a stainless steel pin shall be installed.

- **Bronze (mushroom) plaque**: Marks shall consist of a Bronze Mushroom plaque installed flush in a solid structure, such as concrete (eg berm, kerb or footpath). Where possible the plaque should be stamped with the mark's 4 character geodetic code.

- **Stainless steel pin**: Marks shall consist of a stainless steel pin (minimal 12mm diameter) grouted into a structure such as solid rock or concrete (eg berm, kerb or footpath)

3.3.2 *Marks 4th order or higher*

1. Marks shall consist of a 12 or 22mm stainless steel pin grouted into solid rock where available else a 22mm stainless steel pin set in a stable concrete block.

2. The concrete block shall measure at least 0.35m × 0.35m × 0.5m and be covered by a cast iron protective box and lid (see mark protection structures Figs 5 and 6) placed below or flush with the ground so as not to be a hazard unless there is another form of structure protecting the mark such as a beacon.

3.3.3 *Precise Levelling Benchmarks*

1. Marks shall consist of a 12 or 22mm stainless steel pin grouted into solid rock or an existing concrete structure (such as a culvert or bridge abutment) where available. If no existing solid structure is available, a 22mm stainless steel pin shall set in a stable concrete block. An ID plaque shall be installed (see Section 3.2).

2. The concrete block shall measure at least 0.35m × 0.35m × 0.5m and be covered by a cast iron protective box and lid (see mark protection structures Figs 5 and 6) placed below or flush with the ground so as not to be a hazard. An ID plaque shall be installed (see Section 3.2).

3.4 *Replace an Existing Mark*

A replacement mark shall conform to the following specifications:

1. Where an existing geodetic mark is to be replaced it shall be offset (if necessary) and then removed. A new mark shall be installed so that the new mark is placed both horizontally and vertically to within 3 mm of the position of the existing mark

2. The new ground mark shall comply with the requirements in section 3.3.

3. If the replacement mark cannot be placed in the same position (i.e. within 3mm) it shall be regarded as a new mark, be renamed and allocated a new geodetic code. Contract deliverables are required for both the replaced and the new mark and details as to why given in the Maintenance (Contract) Report.

3.5 *Upgrade an Existing Ground Mark*

When maintenance work or upgrading a mark is carried out on, or is affecting an existing mark, care shall be taken to ensure that the existing mark does not have its position altered either horizontally or vertically. If a mark is damaged or destroyed and requires replacement, see section 3.4.

Where an existing large diameter (greater than 25mm) iron tube is in good condition, the mark shall be upgraded by the installation of a stainless steel pin inside the tube using cement or suitable epoxy resin so that the top of the pin is the same level as the top of the tube.

3.6 *Modify the Height of a Mark*

For various reasons, for example when the top of a pipe is protruding above the ground or is corroded, the height of a geodetic mark may be physically changed during the course of maintaining the mark.

Where the height changes by more than 3 mm the following will apply:

1. A new geodetic code must be assigned to the modified mark and the replacement mark naming convention will apply (i.e. NO 2 is appended to the original name, or NO 3 replaces NO 2, etc.).

2. Details of the original mark and the modified mark are to be included in the Report of Maintenance Work Completed or Required. The Mark Details field

for both marks shall reference the physical changes made to the mark. The Mark Physical State code for the original mark shall be DEST.

3.7 *Stabilise a Mark*

If a mark can be moved horizontally by more than 3 mm or if a new 5th order mark is being installed in soil or sand it shall be made stable. When stabilising a mark the Contractor shall ensure that it does not have its position moved by more than 3 mm in any direction.

To stabilise a mark that is loose in the ground, any nearby vegetation shall be removed and the ground around the mark shall be compacted or replaced with a more stable material as required, in a manner that does not disturb the mark. A concrete collar shall also be installed around the mark.

3.8 *Preserve a Mark*

When the top of an iron pipe or tube is protruding above the ground and is corroding, and as long as the height is not altered by more than 3mm, the tube should be preserved. A PVC pipe should be placed around the corroded tube, to a sufficient depth below ground level to ensure mark stability. Concrete should then be used to secure the corroded tube within the PVC pipe.

3.9 *Offset a Mark (for Reinstatement)*

When required, sufficient new marks shall be installed clear of any unstable or potentially unstable ground so that the mark's position at any future time is known to within 3 mm both horizontally and vertically. Details of the surveyed offsets shall be included in the Maintenance (Contract) report so that it is possible to reinstate the mark.

3.10 *Offset an Existing Low Order Geodetic Mark*

An existing low order geodetic mark may be located in a situation where it does not meet the Compulsory Attributes of the Specifications for Geodetic Control Survey. In this case the existing mark may be replaced with a new mark (not in the same horizontal and vertical position), if:

the existing geodetic mark is proven reliable

AND

the new mark meets all Compulsory and Desirable attributes of the Specifications for Geodetic Control Survey

Reliability checks for the existing mark and survey connections between the new and existing mark are to be provided

3.11 *Maintain a Bench Mark Protruding Above the Ground*

Where the mark being maintained consists of a concrete block protruding between 10cm and 1m above ground level, the exposed concrete block is to be painted white. Prior to painting, all surfaces shall be cleaned (i.e by brushing down or scraping) to remove all loose paint, moss, lichen, etc. Marks protruding more than 1m above ground are considered to be pillars (see Section 4.7).

3.12 *Destroyed or Not Found Marks*

If a geodetic mark is found to be destroyed or it cannot be located within a reasonable time frame (e.g. 15 minutes), the Contractor shall update the Report of Maintenance Work Completed or Required and provide details of the search undertaken to locate the mark in the Maintenance (Contract) Report.

4 Beaconing and Mark Protection

The protection structure shall comply with the specifications detailed below, unless otherwise stated by the National Geodetic Office. However where an existing mark with a 3m or 4m wooden beacon has been upgraded to Order 2000, the beacon may be modified if requested by the National Geodetic Office so that it can be easily removed and accurately replaced over the mark. For these specifications a beacon is considered to be a form of protection structure.

A summary of the protection structure requirements for different orders of marks is contained in Table 1.

Table 1. Standard of mark and protection required for different Order 2000 category marks.

ORDER 2000	0	1	2	3	4	5
MARK TYPE						
Pillar and force centring	**YES**	yes	yes	yes	yes	yes
Pin (12 or 22 mm stainless steel pin, brass or bronze pin)	**NO**	yes	yes	yes	yes	yes
PROTECTION STRUCTURE						
Beacon	**NO**	yes	yes	yes	yes	yes
Marker Post or Post and Rail Enclosure	yes	yes	yes	yes	yes	yes
Cast Iron Cover	**NO**	yes	yes	yes	yes	yes
IDENTIFICATION						
ID Bronze Plaque (next to the mark)	yes	**YES**	**YES**	**YES**	yes	yes
ID Aluminium Plate (on the protection structure)	**YES**	**YES**	**YES**	**YES**	yes	yes

(Note. **UPPERCASE** bold are mandatory, Lowercase are optional)

Zero order 2000 marks are pillars and no beacons are required because a continuously operating GPS receiver will occupy them. A post and rail enclosure is usually required to protect the mark.

For other order marks one or more of the following structures may be required:

1. 2m metal beacon (note that a 4m beacon may be used in some instances)
2. marker post
3. post and rail enclosure
4. cast iron cover for marks 0.2m or more below ground level

Unless advised by the National Geodetic Office, existing cadastral marks upgraded to 5th order shall not be maintained.

Where a new protection structure is being installed on private land, the landowner/occupier's permission is required prior to installation.

4.1 *Identification Plate*

Each mark that is protected by a beacon, marker post, or post and rail enclosure, shall have fixed to the protection structure an identification aluminium plate that is engraved to clearly show the four character geodetic code of the mark**.** The distance to the mark (to one decimal place of a metre) shall be engraved on the plate. Plates are not required where the mark's sole form of protection is a cast iron cover. Any damaged or non-conforming plates shall be removed and replaced when maintenance is undertaken at that mark.

The plate shall be secured to the protection structure as follows:

1. Beacon: on side panel facing usual access.
2. Marker Post: on flat side of post facing the ground mark and within the area painted black.
3. Post and rail: on outside of post or rail closest to usual access.
4. Pillar: on side facing usual access and within the area painted black.

Identification plates are only to be secured to National Geodetic Office property. They are not to be secured to nearby fences, walls, fence posts or power poles.

The aluminium identification plate shall be prefabricated in the form shown in Fig 2 with outside dimensions of 100mm by 125mm. The wording shall conform to that shown in Fig 2.

Fig 2. Identification Aluminium Plate

4.2 *Trig Station Information Plate*

Beacons located at sites readily and frequently accessible to the general public, shall have fixed to them an information aluminium plate engraved to describe the purpose and usage of the beacon and its mark.

The plate shall be secured to the beacon on the side panel facing usual access, as long as the plate is easily readable in this location. If it is not easily readable in this location, no information plate shall be installed.

Any damaged or non-conforming information plates shall be removed and replaced when maintenance is undertaken at that mark.

Information plates are only to be secured to LINZ. They are not to be secured to nearby fences, walls, fence posts or power poles.

The aluminium information plate shall be prefabricated in the form shown in Fig 3 with outside dimensions of 150mm by 200mm. The wording shall conform to that shown in Fig 2.

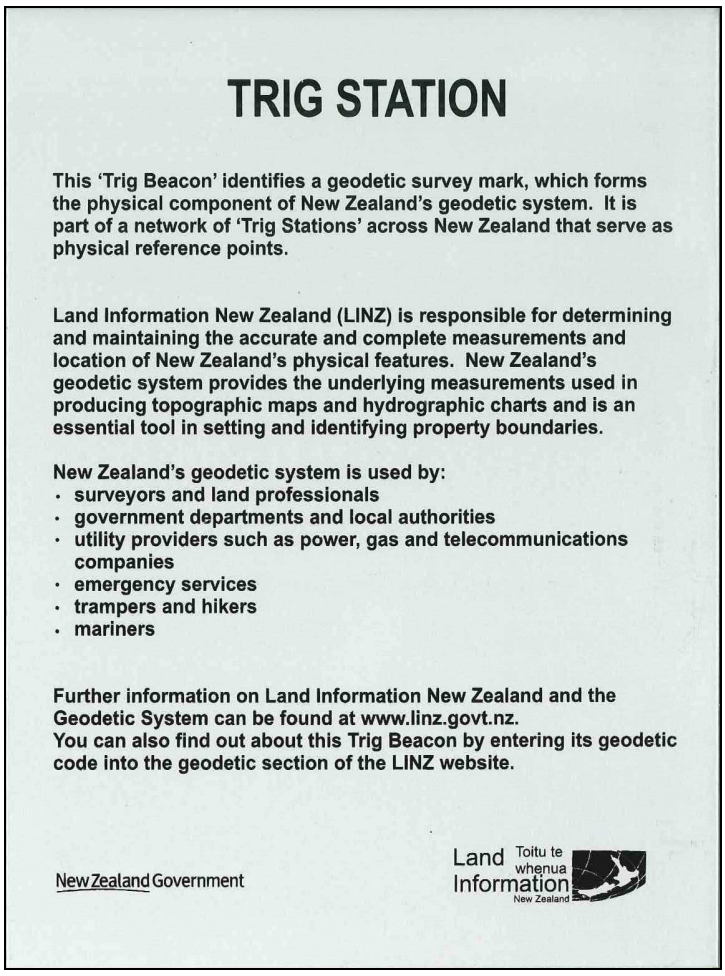

Fig 3. Information Aluminium Plate

4.3 *Beacons*

4.3.1 *New Two Metre Metal Beacon*

The structure is to be a 2m metal beacon such as a Nelson, Clarke or Gisborne beacon or equivalent that has approval of the National Geodetic Office. The specifications for a typical two metre beacon are:

1. All nuts, bolts, screws, washers and 'U' bolts to be stainless steel.

2. a. Side panels, vane panels and vane braces to be 22 gauge galvanised iron sheet metal or stainless steel.
b. Mast braces to be 12 gauge galvanised iron sheet metal.
c. Mast and rafters to be 20 mm dia galvanised iron pipes.
d. Alloy head to be cast aluminium with 28 mm internal diameter steel tubing insert.

3. A stainless steel mast locking pin or other securing bracket, eg a "U bolt", is to be fixed through the mast immediately above the head to prevent the mast rotating and to hold the mast clear of the ground mark. The bottom of the mast is to be at least 20 mm clear of the top of the ground mark to prevent damage to the ground mark.

4. The beacon is to be anchored by clamping the rafters to waratahs using a nut and bolt or a 'U' bolt. The waratah is to be driven firmly into the ground and if necessary a concrete collar placed around it but not the rafter (Fig 4).

5. The height of the top of the alloy head is to be approximately 1.3 m above ground level. Significant variance on this requires explanation.

6. Side panels and vane braces are to be painted white and vane panels painted black.

7. An identification plate is to be securely attached to the side panel facing the usual direction of access.

8. The centre of the mast is to be located vertically over the centre of the mark.

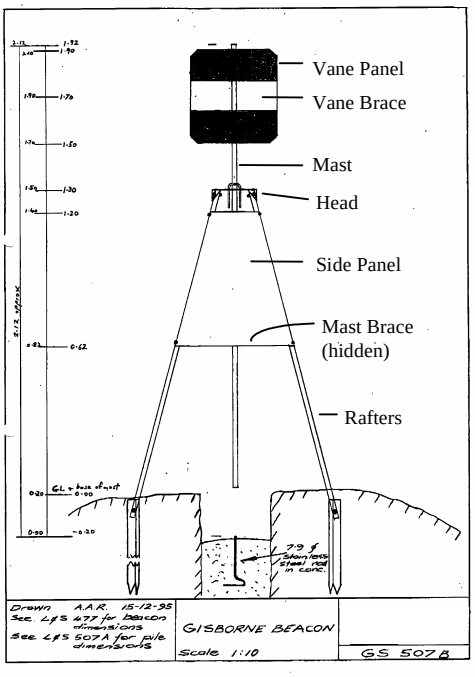

Figure 3. Two Metre Beacon

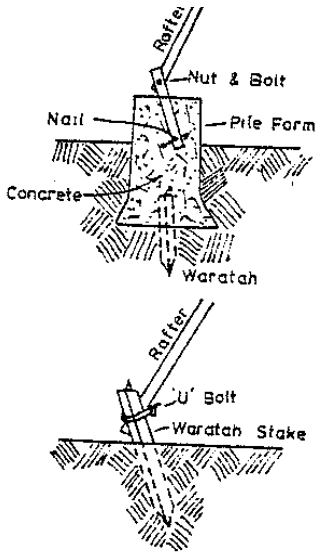

Figure 4. Details of Footings

4.3.2 *Beacon Eccentricity*

When maintaining beacons (painting or repairs) they are to be checked for eccentricity and any eccentricities greater than 0.01m are to be recorded under Beacon Eccentricity field in the Report of Maintenance Work Completed or Required. Offsets with respect to the ground mark shall be recorded. If any eccentricity has been found, beacons shall be centred over the mark where possible.

4.3.3 *Beacon Measurements*

Once beacon maintenance is completed, beacon heights are to be measured vertically with respect to the top of the ground mark. The vertical relationship of the top of the ground mark with respect to ground level shall also be measured.

4.3.4 *Paint a Beacon*

Prior to painting, all surfaces shall be cleaned (eg by brushing down or scraping) to remove all loose paint, moss, lichen etc. Non toxic exterior paints are to be used. Metal structures are to be undercoated with galvanised iron primer.

The following specifications shall be followed for painting a beacon:

1. **Two Metre Metal or Wooden Beacon**: Existing beacons shall be painted to comply with the specification for a New Two Metre Beacon (see Section 4.3.1).

2. **Three and Four Metre Wooden Beacon**: The rafters, rails, mast, mast braces and top and bottom third of the vane panels are to be painted black. The side panels and centre third of the vane panels are to be painted white.

3. **Cone Beacon**: The cone shall have the top and bottom third painted black and the middle third painted white.

4.3.5 *Repair a Beacon*

The Contractor shall supply the materials, replace, secure and paint any damaged components of the beacon including damaged, corroded, rotted or missing rails, rafters, side panels, vane panels, hinges, and holding down devices. The repairs shall restore the beacon to its original state.

4.3.6 *Repairs for Safety*

The Contractor shall supply the materials, remove, replace or secure any damaged or dangerous components of the beacon and/or protection structure including any or all of the following: rails, rafters, side panels, vane panels, hinges, and holding down devices. The repairs shall restore the beacon so that it no longer poses a Heath and Safety risk.

4.3.7 *Modify a Wooden Beacon*

If advised by the National Geodetic Office, wooden beacons shall be modified so that they can be easily removed and accurately re-established over the ground mark by installing brackets at the base of the rafters. Brackets and securing bolts or screws shall be made of galvanised steel or brass.

4.4 *New Marker Post*

The structure is to be a tanalised half round fence post with a minimum diameter of 125mm and approximately 1.8 m long.

1. It is preferable that the post should be placed no further than 5.0 m from the ground mark.

2. At least one third of the post's length is to be buried. This will leave 1.2 m of post exposed above ground level. In soft or sandy soil, posts are to be set in concrete to ensure stability.

3. The flat side of the post is to face the mark.

4. The top 0.3 m of the exposed post is to be painted black, and the rest of the post exposed above ground level is to be painted white.

5. An identification plate is to be secured to the flat side of the post and within the area painted black.

6. Where a mark is situated close to a fence, the new marker post shall be installed immediately against the fence line or as close as possible to it.

7. Existing fence or other posts are not to be used unless explicitly placed for mark identification eg concrete bench mark posts already in place.

4.4.1 *Maintain an Existing Marker Post*

The Contractor shall repaint, straighten and secure an existing marker post taking care to ensure that the ID plate remains undamaged. Prior to painting, all surfaces shall be cleaned (eg by brushing down or scraping) to remove all loose paint, moss, lichen etc. Non toxic exterior paints are to be used.

All work shall be in accordance with Section 4.4. except that the existing marker post does not need to be re-positioned so that the flat side is facing the ground mark where:

1. the mark is likely to remain clearly visible and/or

2. the relationship of the marker post to the ground mark is obvious from the access or finder diagram.

4.5 *New Post and Rail Enclosure*

The structure is to be made up of three or four wooden tanalised fence posts (eg half rounds) approximately 1.8 m long, connected at their tops by wooden rails approximately 3.5 m long. Rails may be tanalised half-round fence posts or lengths of tanalised 100mm x 50mm (ex rails for 4 metre beacons).

1. Posts are to be placed as far as practical equidistant from the ground mark and at a minimum distance of 1.8 m and maximum distance of 2.2 m.

2. At least one third of the post's length is to be buried. This will leave 1.2 m of post exposed above ground level. In soft sandy soil, posts are to be set in concrete to ensure stability.

3. Rails are to be secured to the top of the posts using screwed in metal straps or galvanized bolts and are to be generally level.

4. The rails and tops of posts at rail level are to be painted white, and the rest of the posts exposed above ground level are to be painted black.

5. An identification plate is to be secured to the post or rail closest to the usual point of access.

4.5.1 *Maintain an Existing Post and Rail Enclosure*

The Contractor shall repaint, straighten and secure an existing post and rail enclosure and shall supply and replace any damaged members taking care to ensure that the ID plate remains undamaged. Prior to painting, all surfaces shall be cleaned (eg by brushing down or scraping) to remove all loose paint, moss, lichen etc. Non toxic exterior paints are to be used. All work shall be in accordance with Section 4.5.

4.6 *Cast Iron Cover*

4.6.1 *Cast Iron Cover*

Cast iron covers shall be installed to finish flush with the ground surface. They shall be constructed and installed as shown in Fig 5 and 6.

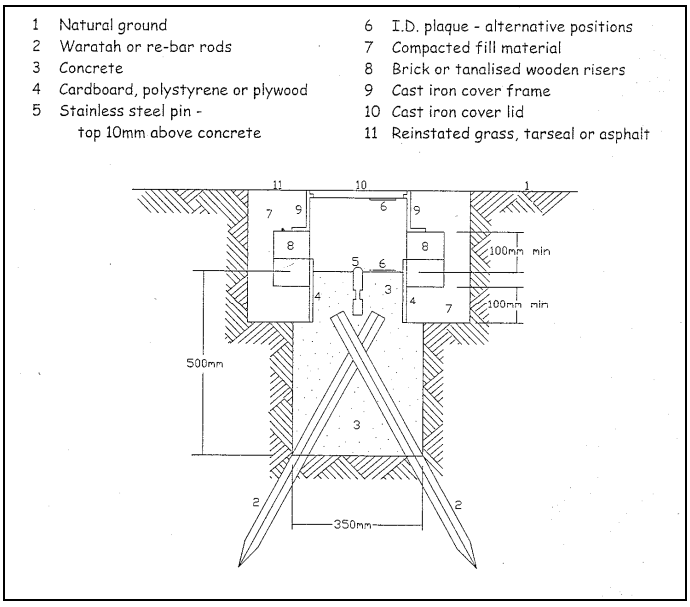

Fig 5. Diagram of a new Mark

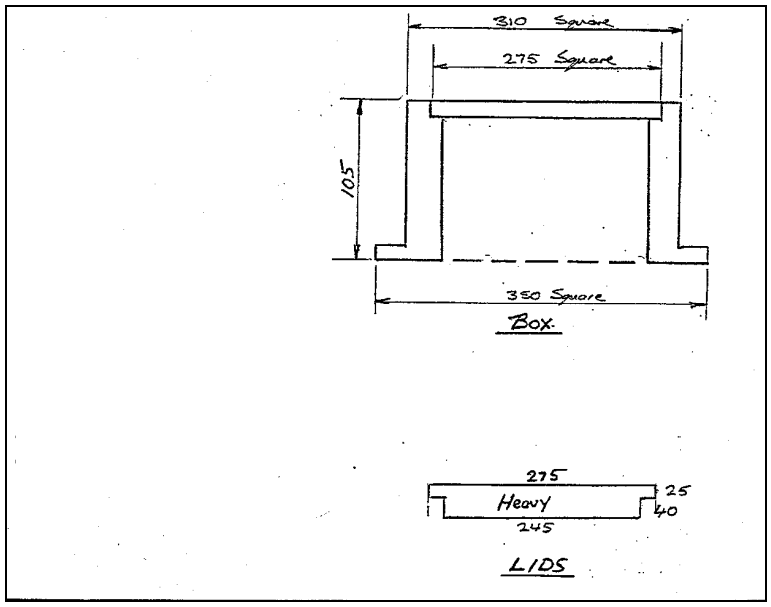

Fig 6. Cast Iron Box and Lid ('SURVEY MARK' to be cast into top of lid)

4.6.2 *Raise or Lower Cast Iron Cover*

The Contractor shall raise or lower the existing protection cover and place it firmly and durably in place flush with the surrounding surface. Any surface that the box is sitting on shall be adjusted or replaced accordingly. In the event that the Contractor has disturbed the existing surface at ground level, then this surface shall be reinstated to a standard and finish at least equivalent to that which existed.

4.6.3 *Replace a Cast Iron Cover*

The Contractor shall supply and install a new cast iron box and lid (see Figure 6) in place of the existing protection cover. The new cover shall be placed over the mark without disturbing it in any way so that it is both firmly and durably in place flush with the surrounding surface. The base of the cover shall be isolated from the concrete base by a material such as plywood, or polystyrene spacers. In the event that the Contractor has disturbed the existing surface at ground level, then this surface shall be reinstated to a standard and finish at least equivalent to that which existed.

4.6.4 *Replace a Cast Iron or Concrete Lid*

The Contractor shall supply and fit a new cast iron or concrete lid to the existing box and remove and dispose of the existing damaged lid if it exists. Note that lid sizes may vary from area to area. Where a new lid cannot be obtained to fit the existing box a new box and lid shall be installed in accordance with section 4.6.3.

4.7 *Maintain a Pillar*

Pillars are considered to be structures over 1m high that can be observed to. The top and bottom third of a pillar is to be painted white and the central third black. An identification plate is to be secured to the pillar within the area painted black and facing the usual means of access. For maintenance contract deliverables, pillars are considered as beacons.

4.8 *Maintain a PositioNZ Site*

The upper side of all solar panels, where they exist (some sites are mains powered), are to be cleaned. This shall be done by wiping the panels with either a damp cloth or soft paper to get rid of any dust. If bird droppings or something similar will not easily wipe off, then application of a mild detergent such as dish washing liquid using a soft scrubbing brush may be necessary. It is generally expected that regular rain keeps solar panels clean in most places.

All GPS and ancillary equipment plus visible cables on site are to be **visually inspected only**, with specific attention to any obvious wear and tear or damage due to the wind or other elements. Inspection shall also include looking out for insecure fittings due to loose or missing screws/bolts.

If vegetation growth is hindering or likely to hinder equipment performance, particularly the solar panels and GPS antenna, this is to be cleared with careful regard to cables and wiring that may be close to where the clearing is needed.

Before and after photos are to be taken as well as notes detailing the condition of the site equipment.

Most PositioNZ sites are protected by Post & Rail Enclosures which have not been painted. These are to remain not painted. If, however, some loose boards exist, or some other hazard is apparent, which can be repaired, such work shall be carried out.

5 Inventory Service

The field component of the Inventory Function shall consist of:

- Location and identification of the bench mark
- Assessment of the status and condition of the bench mark
- Assessment of what maintenance is required
- Any necessary physical maintenance to eliminate any health and safety issues
- Capture of NZGD2000 coordinates accurate to 5m (eg using handheld GPS) for any marks where the NZGD2000 order is 10, 11 or 12.

Any work carried out for health and safety reasons under Inventory shall be in accordance with the relevant sections of this specification.

6 Contract Deliverables

The format and content of the contract deliverables for Geodetic Physical Network are contained in the Specifications for Geodetic Contract Deliverables.