



Department of Lands

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**SPECIFICATIONS**

**FOR**

**THIRD ORDER  
LEVELLING**

**DEPARTMENT OF LANDS**

**New South Wales**

SPECIFICATION

for  
THIRD ORDER LEVELLING

NEW SOUTH WALES

TECHNICAL REQUIREMENTS

1. Datum

All levels shall be based on Australian Height Datum (A.H.D.) as defined by at least two Bench Mark Values supplied by the Surveyor General. Levelling operations shall commence at these originating Bench Marks.

2. Equipment

All levelling shall be carried out with modern precision levels of the automatic collimation or similar type and with calibrated invar levelling staves.

3. Lines of Levelling

The levelling of each section shall be carried out in both forward and backward direction at substantially different times (preferably one way in the morning and the reverse in the afternoon). The two staff method shall be employed where possible and the interval of time between consecutive sights at each set up of the level shall be kept to a minimum.

4. Bench Marks

The Surveyor shall locate Bench Marks as placed and effect levelling to each of such marks. Where any Bench Mark is destroyed, damaged or not located, the circumstances are to be reported to Survey Control Branch (Sydney). Where an alternate Bench Mark is established, such should conform, with specifications for marking control surveys. Each Bench Mark is to be fully described in the field level book or electronic data recorder.

5. Recovery Data  
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The Surveyor should examine the numbering of each Bench Mark to ensure that such agrees with the detail shown on the diagram, sketch or description provided. He should also annotate the diagram or sketch with any further information to facilitate location in the future.

6. Accuracy  
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The two levellings of each section between Permanent Bench Marks shall not differ by more than  $0.012\text{m} \sqrt{\text{km}}$  where km is the distance between Permanent Bench Marks in kilometres.

7. Records  
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A record of all field observations shall be by electronic data recorder with an approved program or be written in ink in an appropriate field book. No erasures, blotting out or overwriting should be made in the field book. Incorrect readings may be lightly ruled in ink, with the corrected field reading noted in ink on the next line below the cancelled reading.

Only original notes will be accepted. Transcription of original notes are unacceptable.

Final adjustment of levels to a common datum will be arranged by Survey Control Branch (Sydney).

Any subsequent notations in the field level books, other than actual observed readings, are to be neatly made in pencil to avoid confusion with field readings.

Where a section of levelling has to be repeated an entirely separate record is required with the appropriate cross reference and cancellation of the superseded data.

Location sketches to adequately define the general location of each line of levels shall be drawn in each field level book.

8. Reports

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On completion of the work the Surveyor shall supply a report to Survey Control Branch (Sydney) on the whole of the survey. The report shall include:-

- (i) An appropriate diagram of the survey showing the approximate locations of permanent bench marks in relation to the local road system.
- (ii) A list of the differences in level between successive bench marks as determined by the two or more levelling runs. Where any run has been rejected the list should be prominently noted.
- (iii) The adopted mean value of the observations in each section.
- (iv) Maps, diagrams, sketches as provided originally with the instruction.

9. Certification

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At the conclusion of work each day the responsible Surveyor shall initial and date every level book page on which observations have been recorded during the day. Each level book and all reports required in the terms of this specification shall be certified by the Surveyor.

10. Instruments

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The Surveyor shall ensure that all equipment used is maintained in adjustment during the survey. Field tests for vertical collimation error shall be made at the commencement and completion of the survey and at intervals not exceeding thirty kilometres during the progress of the work. The consultant will assume full responsibility for the performance of the level instrument used.

All field tests are to be fully recorded in an appropriate field book and the residual errors before and after adjustment should be noted. A complete page of the field level book is to be used for each vertical collimation test. This field book is to be maintained by the Surveyor and made available to Survey Control Branch (Sydney) on request. A method of collimation check is detailed in Appendix 'A' attached hereto.

11. Staff Calibration

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All invar staves shall be calibrated and the certificate made available when required.

12. Use of Automatic Collimation Levels  
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At each setting the instrument should be levelled by the circular bubble within the tolerance laid down in the manufacturer's handbook. The level must always be set firmly so as to ensure complete stability during observations. The circular bubble must be in precise adjustment at all times.

13. Staves  
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The staves used must be handled with care and every effort made to preserve the markings from defacement.

14. Lengths of Sight  
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The length of any levelling sight shall be such as to allow the positive resolution of staff graduations and no sight shall exceed one hundred metres. Lengths of Back and Fore sights should be near to equal. The interval can be determined by pacing, stadia or other appropriate means. The total lengths of back sights foresights in each Section of levelling between Bench Marks should balance.

Levels shall only be taken when atmospheric conditions allow reading the staff with certainty. If unfavourable conditions are encountered the length of sight shall be reduced until certainty can be achieved.

15. Placement of Staves  
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The base of each stave should be inspected and kept free of all foreign materials. Metal base plates of a design approved by the Surveyor General are preferred as the staff footing at each change point. Departure from the procedure shall be reported and method use justified. The staff shall be held vertical in accordance with sound survey practice.

16. Readings  
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The staff readings shall be recorded to the nearest millimetre.

17. Ground Conditions  
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All sight lines shall clear the intervening ground between the level and staff by at least 0.2m.

18. Holding Marks  
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If, for any reason, levelling operations have to be suspended for a period, a substantial and stable holding mark shall be established at the terminal.

When circumstances oblige a holding mark to be in use overnight or for longer periods, a subsidiary Bench Mark shall be established and detail fully documented in the field book.

# Sample of Field (test) Book

Instrument No. Topcon  
 Observer A. Person  
 Staff No. (A) 1749  
 Staff No. (B) 1750  
 Date 4-8-90  
 Weather Sunny

## APPENDIX A

### Secondary Levelling

#### Example Collimation Adjustment

- at (1) sight A (long sight) & read/record  
           sight B (short sight) & read/record  
 at (2) sight A (short sight) & read/record  
           sight B (long sight) & read/record

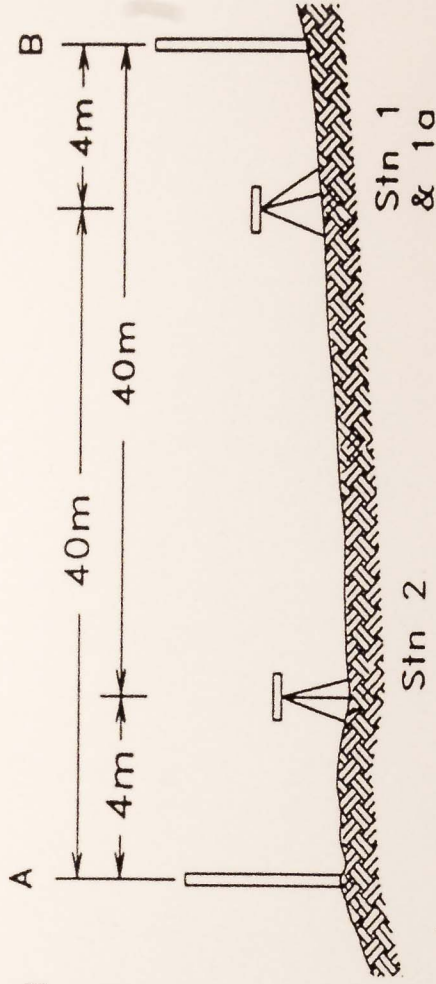
(1) 40m Staff A 1.632m  
       4m Staff B 1.301m  
                   0.331m

(2) 4m Staff A 1.684m  
       40m Staff B 1.361m  
                   0.323m

0.008m is collimation error. Carry out adjustment.

- (2) Reset as necessary on long sight (staff B) & record  
       40m Staff B 1.356m  
       4m Staff A 1.684m  
                   0.328m

(1a) 4m Staff B 1.326m  
       40m Staff A 1.654m  
                   0.328m



NOTE: Do not adjust if 0.002m or less