CARRY OUT BASIC LEVELLING

RIICCM208D

COMPLIANCE DOCUMENTS

- Legislative, organisational and site requirements and procedures;
- Manufacturer's guidelines and specifications;
- Australian Standards;
- Employment and workplace relations legislation; and
- Equal Employment Opportunity and Disability Discrimination legislation

REGULATORY AND LEGISLATIVE REQUIREMENTS

- Work Health and Safety Act 2011
- Work Health and Safety Regulation 2011
- Electrical Safety Act 2002
- Electrical Safety Regulation 2002
- Environmental Protection Act 1994
- Aboriginal Cultural Heritage Act 2003

GUIDANCE DOCUMENTS

- Plant Code of Practice 2005, Workplace Health and Safety Queensland.
- Managing the Risks of Plant in the Workplace 2012, Safe Work Australia.
- Construction work Code of Practice 2012, Safe Work Australia.
- Excavation Work Code of Practice 2012, Safe Work Australia.
- Electrical Safety Code of Practice 2010 Working Near Exposed Live Parts, Electrical Safety Office Queensland.
- Traffic Management for Construction or Maintenance Work Code of Practice 2008, Workplace Health and Safety Queensland
- Manual of Uniform Traffic Control Devices Part 3 (MUTCD Part 3)
- Any relevant standards that provide guidance.
- Manufacturers Specifications and Instructions
- Other Workplace and Organisational Requirements

WORK INSTRUCTIONS

- Verbal or written and graphical instructions, signage, work schedules/plans/specifications, work bulletins, charts and hand drawings, memos, materials safety data sheets (MSDS) and diagrams or sketches;
- Plans and specifications;
- Quality requirements, including dimensions, tolerances, standards of work and material standards; and
- Safe work procedures or equivalent.

CONSTRUCTION PLANS AND SPECIFICATIONS

- Prior to commencing any work on a new project, study the drawings carefully so that you can form an idea of what the task entails.
- As well you should check:
  - Regulations e.g. working near railways;
  - Existing underground services;
  - Site conditions;
  - Effects on existing structures and the environment;
  - Construction plans and specifications; and
  - Quality requirements.

OPERATIONAL DETAILS

- Site Conditions;
- Working around Services; and
- Site Preparation.

SAFETY REQUIREMENTS

- Work Health and Safety Act 2011
- Administration of the Act
- Objective of the Act
- Work Health and Safety Regulation 2011
- Understanding the Work Health and Safety Act 2011

DUTY OF CARE

- "Duty of Care" is a common law term used to describe how a person may have responsibilities to the safety and wellbeing of another person.
- Duty of care is often the basis of cases in civil courts to show negligence.
  - A duty imposed on a person to ensure health and safety requires the person –
  - To eliminate risks to health and safety, so far as is reasonably practicable; and
  - If it is not reasonably practicable to eliminate risks to health and safety, to minimise those risks so far as is reasonably practicable.
    - What is 'reasonably practicable' in ensuring health and safety?
    - Duty of Care parties

INCIDENT NOTIFICATION (WHS ACT 2011)

According to the Workplace Health and Safety Act 2011; section 35-39 - a PCBU must notify the relevant state authority as soon as they become aware of a death, or a serious injury or illness that results in:

- Immediate hospital treatment as an in-patient
- Immediate medical treatment for injuries (e.g. amputation, scalping, a spinal injury, loss of a bodily function or a serious laceration, burn, head or eye injury), or
- Medical treatment within 48 hours of exposure to a substance.
    - A serious illness (regulation 669) is:
        - Any infection to which the carrying out of work is a significant contributing factor, including any infection that is attributable to carrying out work
        - PCBU.

SAFE WORK METHODS STATEMENTS (SWMS)

Safe work method statements (SWMS) assist a PCBU to consider how certain activities will be carried out safely.

The following should be noted:

- SWMS must be easy to understand, signed and dated;
- SWMS must be amended if there is a change in the activity and a copy must be given to the principal contactor;
- All persons affected by changes must be advised of amendments to the work method statement; and
- The Work Health and Safety Regulation (2011) states that where a PCBU is required to carry out high risk construction work, a safe work method statement must be prepared, or have already been prepared by another person, for the proposed work before that work commences.

LASER EQUIPMENT

The WHS Regulation 2011 states:
(R) 223 Lasers

1. This section applies to the person with management or control, at a workplace, of laser equipment that may create a risk to health and safety.
2. The person must ensure that laser equipment intended for use on plant is designed, constructed and installed so as to prevent accidental irradiation of any person.
3. The person must ensure that laser equipment on plant is protected so that any operator of the plant or other person is not exposed to direct radiation, radiation produced by reflection or diffusion or secondary radiation.
4. The person must ensure that the visual equipment used for the observation or adjustment of laser equipment on plant causes no risk to health or safety from laser rays.
5. The person must ensure that the workers operating the laser equipment are trained in the proper operation of the equipment.
6. The person must ensure that Class 3B and Class 4 lasers (within the meaning of AS 2397 Safe Use of Lasers in the Building and Construction Industry) are not used in construction work.

TRAFFIC

There are numerous ways to control the risks associated with working on roads or road-related areas.

Following are some examples of a number of traffic control measures that may be considered:

- Road closures;
- Footpath closures;
- Detours;
- Signing; and
- Traffic controllers.

SIGNAGE AND BARRICADE REQUIREMENTS

Industry signage and barricades will be used as part of a health and safety hazard strategy.

This is a systematic process of eliminating or reducing the risk to personnel and property through the application of controls.

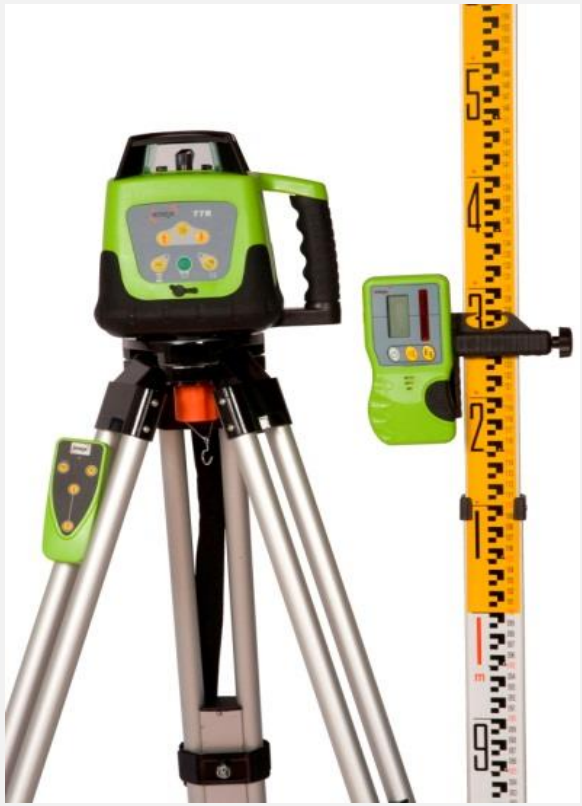
- Signage and barricades form part of the following hazard control measures:
- Signage – is an administrative control; this relies on work methods or procedures that are designed to minimise exposure to a hazard; and
- Barriers – are an isolation control; they are designed to isolate the hazard from people.

Ensure that you have a basic knowledge and understanding of the meanings of signs and symbols used to communicate safety on a construction site.
In Australia there are four basic categories of sign:

- Regulatory Signs;
- Hazard Signs;
- Emergency Information Signs; and
- Fire Signs.

Consider and plan carefully for the placement of signage and barricades.

TOOLS AND EQUIPMENT



Tools and equipment may include:

- Levelling devices including: spirit levels; laser levels; string lines; tape measures; automatic levels; survey pegs; levelling staffs; plumb bobs; optical square; inclinometers; batter pegs/boards; wooded/steel pegs; straight edges; hammers; chalk line.

Levelling tasks may include:

- Transferring levels/heights for formwork; earthwork; roadwork; pipework; drainage works; positioning offsets; recovery pegs.

- Straight Edges
- Spirit Levels
- 30-Meter Set-out Tape
- Plumb Bob
- Line Level
- Theodolite
- Tripods
- Automatic and Laser Levels

LASER CLARIFICATION

CLASS 1	CLASS 2	CLASS 3	CLASS 3B	CLASS 4
Are safe for use under all conditions of exposure	Are low power devices, presenting little or no potential hazards. Eye protection is normally afforded by normal blink and aversion responses.	Emit higher levels of light with visible radiation. Their use requires more stringent engineering and administrative precautions than those necessary with Class 2.	Lasers emit either invisible or visible radiation, potentially hazardous to the eye and skin.	Are high power devices capable of producing diffuse reflections which are hazardous to the eyes. Skin exposure to the direct beam of a Class 4 laser is also hazardous

LASER CLARIFICATION REQUIREMENTS

Class 1

There are no special requirements to be observed in the use of Class 1 lasers. These products are completely safe and represent no hazard under normal use.

Class 2

Generally incapable of causing eye injury, however, the following safety requirements must be observed:

- A suitably qualified laser safety officer must be appointed to implement the suitable controls for a Class 2 laser
- Operators must be suitably qualified;
- The laser must be used and maintained in accordance with the manufacturer's instructions;
- Area warning signs of the relevant type as specified in AS2211 must be displayed in conspicuous locations both inside and outside the work area and also on doors, giving access to the work area; and
- The laser beam must not be deliberately aimed at personnel.

LASER CLARIFICATION REQUIREMENTS

Class 3

Generally incapable of causing eye injury or skin damage from diffuse reflection or exposure, however, they may present potential for eye injury if:

- Viewed directly with an optical instrument;
- Reflected light is viewed with an optical instrument; and
- The blink reflex action is deliberately suppressed.

The safety requirements for Class 3 lasers include:

- A responsible person shall be appointed as a Laser Safety Officer (LSO) to access and implement controls appropriate to the Class 3A laser, the type of installation and the associated hazards.
- Only suitably trained personnel approved by the LSO shall be allowed to install, adjust and operate the laser equipment.
- The laser shall be used and maintained in accordance with the manufacturer's instructions.
- Area warning signs or the relevant type specified in AS2211 for Class 3A lasers shall be displayed in conspicuous locations both inside and outside the work area and on doors giving access to the area.
- Precautions shall be taken to ensure that persons do not look directly into the laser beam.

LASER CLARIFICATION REQUIREMENTS

- Precautions shall be taken to prevent 'scattering' of the beam into other areas (e.g. by removal of ladders, containers and the like from the beam pitch).

- Precautions shall be taken to ensure that the laser beam is not directed to specular (mirror- like) surfaces (because reflections from such surfaces have the same qualities as the direct beam).

- Direct viewing of the laser beam through optical instruments e.g. theodolites, binoculars, telescopes, shall not be permitted.

- Wherever possible, alignment shall be undertaken using an electronic sensing device (receptor) or with a diffuse target.

LASER CLARIFICATION REQUIREMENTS

- Lasers of the 'fixed beam' type, e.g. non-rotating, shall be terminated by a beam stop at the boundary of the operational area.
- The laser shall be rigidly mounted so that the directions of the laser beam cannot be accidentally altered.
- The laser beam path shall be located well above or well below eye level. Where such a path location is impractical, the Laser Safety Officer shall specifically authorise another path location.
- When not in use, the laser shall be stored in a location where unauthorised personnel cannot gain access. When it is unsupervised, the laser hall have hoods or shutters placed over the laser apertures or be disconnected from power source, e.g. by removal and storage of power lead.

PROBLEMS WITH LASERS

When lasers are used over very long distances, two problems occur to influence the accuracy of the laser beam. These problems are:

- Refraction of the light beam - this is the bending of light at the interface of two substances caused by a difference in speed of light.
- This is the temperature difference in the air.

Allowance for curvature of the earth - the problem caused by curvature of the earth is that the light beam does not follow the shape of the earth.

- The light beam continues on in a flat plane which appears to move away from the earth's surface.
- The correction to overcome this problem is usually very small.
- For example:

DISTANCE	CORRECTION
150m	1.55mm
300m	6.0mm
450m	15mm
600m	24mm

TOOLS AND EQUIPMENT

Maintenance and Inspections

Checking levelling equipment within specified tolerances requires you to perform tolerance checks including the two peg test for automatic level; and reverse readings for spirit levels. These tests will be covered further in the manual when you start to understand how to use the equipment better. Tests are performed because all instruments are subject to errors of calibration and adjustment.

DEFECTIVE EQUIPMENT PROTOCOL

1. STOP
2. TAG
3. REPORT
4. RECORD

HYDROSTATIC OR WATER LEVEL

The level should be checked before use:
Ensure that both ends are open to the atmosphere that the liquid heights are the same when the tubes are held side by side that the tube has no air bubbles.
The water level is very useful when transferring level points inside an existing building because the flexible tube can be moved around obstacles.

OPTICAL LEVELS

Optical levels are broken into three basic types:

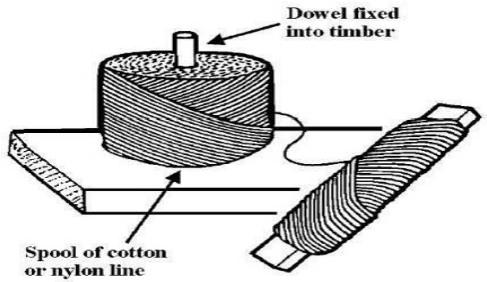
- Dumpy levels
- Tilting levels (often called engineer's or quickset levels)
- Automatic levels.

METRIC STAFF AND BONING RODS

TOOL	DEFINITION
METRIC STAFF	Metric staff being used at the majority of construction sites is an 'E' type; the name being taken from the general shape of the markings.
BONING RODS	Boning rods consist of a set of three rods each in the form of a tee. Two are the same length, and the third has the depth of the trench added to the bottom. They are all the same length, about 1 metre, and have a cross piece about 300 mm long. Each cross piece should be painted a different colour, so that the eye can readily pick up the edge.

TOOLS FOR MARKING POSITION

- Pegs and Pins
- String Line
- Chalk Line



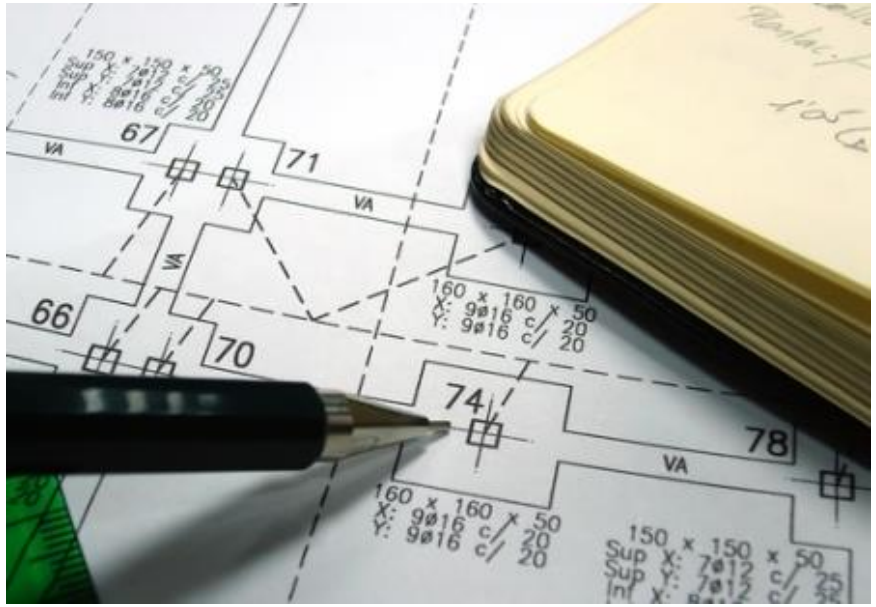
ENVIRONMENTAL PROTECTION REQUIREMENTS

- To determine environmental requirements you will need to access and consider the Environmental Management Plan (EMP) relevant to the particular project.
  - An Environmental Management Plan (EMP) is a site or project specific plan developed to ensure that appropriate environmental management practices are followed during a project's construction and/or operation.

- An effective EMP should ensure:
  - Application of best practice environmental management to a project;
  - The implementation of a project's environmental impact assessment (EIA) including its conditions of approval or consent;
  - Compliance with environmental legislation; and
  - The environmental risks associated with a project are properly managed.

SETTING OUT PHASES

- Preparation and setting out the road works.
- Offsetting the survey centre line and pegs.
- Control of shape and level in subgrade and pavement.



SETTING OUT DRAINAGE

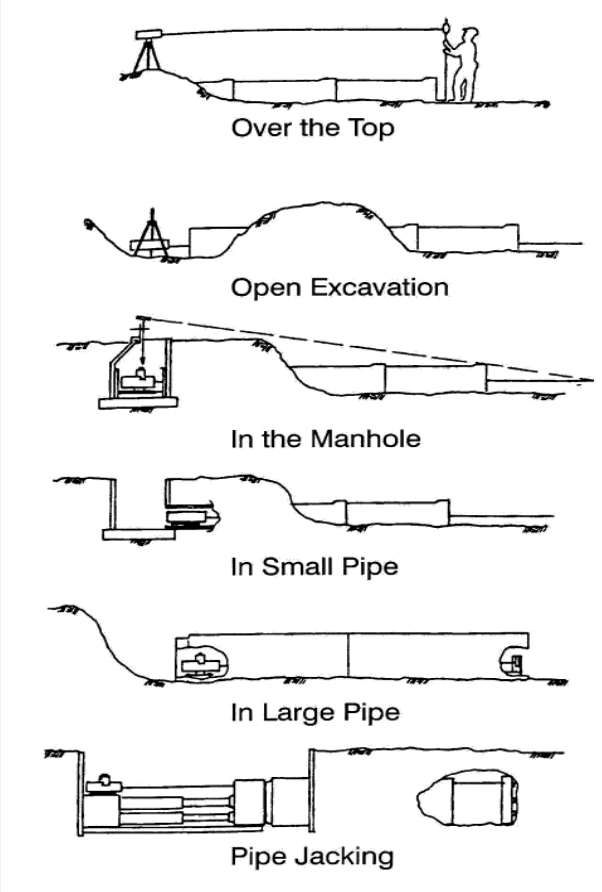
- Stages in setting out for pipe drainage lines.
- Offsetting the survey control line and pegs.
- Setting out for clearing.

SETTING OUT FOR TRENCH EXCAVATION

Once the centre-line has been established and offset, it will be necessary to set up level and position controls for the excavator.
This will need to be done to ensure the pipe is laid on the established alignment and to the correct invert level.

- Profile Boards
- Laser Beams

SETTING UP A LASER



- Pipe Laying

  The laser is set up to the centre-line or at a particular height from the invert of the pipe.
  The target is placed on the outer end of the pipe segment being laid and the position of the pipe is adjusted until the light spot appears at the centre of the target.
  This ensures that the pipe is positioned to correct line and level without requiring a check by conventional survey means.

- Excavation

  The laser line can be used as a reference line for trench excavation. When the light spot hits a pre-set line marked on the extended boning rod used as the traveller, the excavation is at the correct level.

SETTING OUT PRE-CAST PIPE CULVERTS

- The purpose of setting out open drains and culverts is two-fold:
  - To ensure that open drains are correctly sited and graded to collect surface run-off, convey it rapidly to culvert structures and disperse it satisfactorily on the downstream side of the road;
  - To ensure that culverts are laid at the correct location on the correct line (at right angles or skewed) and with the correct invert level at both inlet and outlet.

SETTING OUT A CULVERT FROM A CONTROL WITH AN AUTOMATIC LEVEL

After making sure that you have the correct plans and that you are in the correct location, you will need the following equipment:

- Hammers, pegs, tapes, stringlines, spirit level, automatic level or theodolite and material for theodolite and material for hurdles.

You are now ready to set out the culvert. The steps are as follows:

- Locate the pegs on the control line.
- If a peg has not been set in place for the culvert you should measure from the peg shown on the drawing to the centre of the culvert using given measurements.
- Set up the automatic level directly over the culvert centre-line peg using a plumb bob.

SETTING OUT A CULVERT FROM A CONTROL WITH AN AUTOMATIC LEVEL

Sight the next control line peg through the level. Have an offsider hold in a straight edge plumb using a 1.2 m spirit level and brace sight one side (comer) of sight. This should be on the centre of the peg.

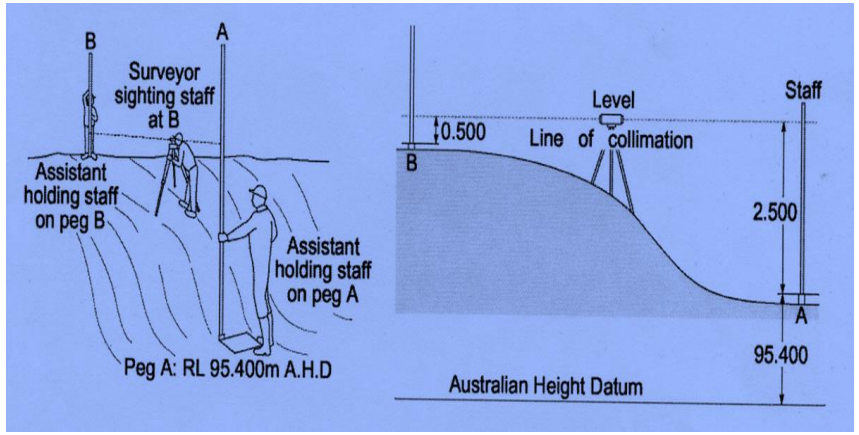
- Set a planetary disc on automatic level to zero.
- Turn the automatic level so that it is 90° to the control line.
- Shoot the edge of the straight edge as before. This will prove the position of the peg outside of works area.
- Drive the peg into the ground.
- Shoot the straight edge again on top of the peg and mark centre-line on the peg. Drive a nail into peg.
- Tum the level 180° and repeat steps the last three.
- Set profile arms to the required levels after taking a reading from the nearest benchmark.

IDENTIFY HEIGHTS

- Drawing/sketch
- Verbal or written instructions
- Datum/survey peg
- Chalk or nail mark
- Mark on vertical surface

Levelling is the determination of the difference in height between two points. Levels can only be given relative to some other point or plane.

- When a series of points are given relative to a common reference plane, the point is known as a datum.
- In surveying the level datum used is Australian Height Datum (AHD).



PROJECT PLANS OR INSTRUCTIONS

All the information to conduct basic levelling should be provided in the complete set of plans and drawings for the project being undertaken.

- A set of working drawings usually includes:
  - A site plan;
  - Elevations;
  - Sections;
  - Details;

- Specifications; including:
  - Title panel;
  - Legend;
  - Notes; and
  - Notations.
- Expression of Levels
- Levels on Plan
- Spot Levels
- Contour Lines
- Grade Levels
- Surface Levels

DATUM

- In surveying and geodesy, a datum is a set of reference points on the Earth's surface against which position measurements are made.
  - On construction plans the datum level is the starting point from which all other measurements will be taken in regards to the height of the structure.
  - Like a grid line the datum is a reference point.
  - All floor heights, ceiling heights, and the like will be measured from this point.

SET UP AND USE LEVELLING INSTRUMENTS

Spirit Levels

- When plumbing or levelling work around the construction site, the spirit level should be used, using the following procedure.
- Place the edge of the level in the centre of the work.
- Observe the position of the bubble in relation to the graduation lines.
- Adjust the work until the bubble is contained between the graduation lines.

SET UP AND USE LEVELLING INSTRUMENTS

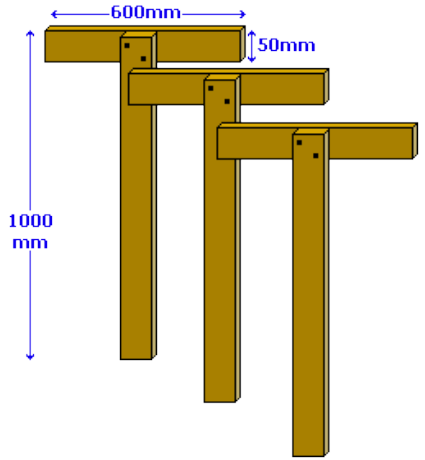
Line Level

To use a line level, use the following procedure:

- Attach the line over the top of the level datum.
- Drive a timber stake at, or near, the required level transfer point; attach the other end of the line to it.
- Place the line level in the centre of the line, which must be tight to ensure that as much sag as possible is removed.
- Adjust the height of the line at the stake end until the bubble registers 'level'.
- Accurately mark this position on the stake. Loosen the line and turn the line level end-for-end.
- Make a second level reading as before and mark the position on the stake.
- Take the centre of the two readings as being the level line.

SET UP AND USE LEVELLING INSTRUMENTS

Boning Rods



The procedure for use is as follows:

- The end pegs in the line are driven to the required depth.
- One of the rods is held on each of the end pegs and a sighting is taken over the tops from one to the other.
- A third rod is used on the intermediate pegs which are driven into the ground one at a time until the top of the rod resting on them is in line with the top of the rods on the two end pegs.
- This procedure should bring the tops of all the pegs into the one line.

SET UP AND USE LEVELLING INSTRUMENTS

Water Levels

- Holding one end, with the water level on or near the desired height, raise or lower the other end until the level of the water settles on the desired height. The other end is marked onto the wall, creating points of equal or level heights.
  - Note: Food dyes may be added to the water to give it an easily seen colour.

SET UP AND USE LEVELLING INSTRUMENTS

Optical Level

Dumpy Levels

- Theoretically after the bubble has been centred the dumpy level can be rotated 360° without any further adjustment.
- However in practice this is not true.
- Before readings are taken the bubble must be perfectly centred, therefore continual small adjustments of the spirit level must be made by the only means available - the levelling screws.

NOTE: If the sun shines on one end of the bubble the heat difference between each end can cause the bubble to move to the warmest end. If this happens, shade the bubble for a few minutes to allow the bubble to achieve its true position.

SET UP AND USE LEVELLING INSTRUMENTS

Automatic Levels

- The instrument is fitted with a small circular spirit level, the bubble being centred in a circle by the levelling arrangement (three levelling screws, the ball and socket, or a combination of the both arrangements).
- As long as the instrument is approximately level (bubble is in centre of circle) the pendulum will compensate and take up a truly vertical position, allowing accurate readings to be achieved without any further adjustment.

SET UP AND USE LEVELLING INSTRUMENTS

Laser Level

There are four (4) main adjustments to be made to a laser levelling instrument before accurate readings can be made.

1. Set up tripod;
2. Telescope must be levelled;
3. Telescope must be adjusted for parallax to suit each operator; and
4. Telescope must be focused.

SET UP AND USE LEVELLING INSTRUMENTS

Parallax Adjustment

Because people's eyesight varies, the telescope must be adjusted for parallax by each observer before accurate readings are possible.

When adjusting the telescope for parallax the following procedure should be adopted:

- Adjust the telescope image out of focus (to infinity).
- Carefully focus the eyepiece until the cross hairs appear black and sharply defined (hold a piece of white paper in front of the telescope at 45 degrees to reflect light into the telescope to illuminate the internal diaphragm).
- Sight some distant object and focus the telescope until the image is clearly defined.
- Check for parallax - if the eye is moved, there should be no apparent movement of the cross hairs and parallax has been eliminated.

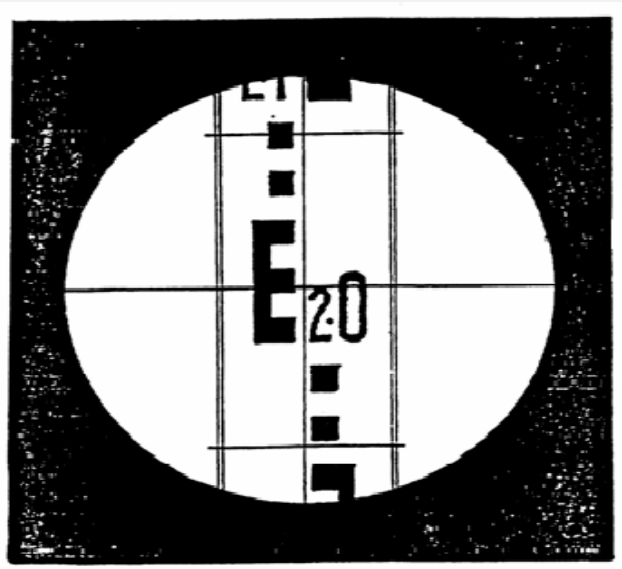
SET UP AND USE LEVELLING INSTRUMENTS

Use of Horizontal Circle

This device may be used for:

- Initial setting out or approximate squaring of buildings and/or site works with final checking to be carried out using steel tape.
- To plot the approximate position of building or object relative to the site boundaries.

STADIA SYSTEM



There are two types of instruments used for stadia surveying.

- In the first type the distance between the two stadia hairs in the theodolite telescope is fixed.

- In the second type of equipment the distance between the stadia hairs is variable, being measured by means of a micrometer.

The stadia lines are used to establish the distance to the staff from the instrument.

<u>Procedure:</u>

- Note the staff reading of top stadia line;
- Note the staff reading of bottom stadia line;
- Finds the difference between the two readings; and
- Multiply the difference by 100 which gives the approximate distance
  (accurate within 1 00 mm).

LEVELLING DEVICE TOLERANCE CHECK

Two Peg Test

- Select two points ‘A’ and ‘B’ 60m to 100m max. Apart and hammer two pegs firmly into the ground.
    - Note: the further apart point ‘A’ and ‘B’ are the more obvious any inaccuracies will be.
  - Set up level midway between the pegs at Point ‘C’ and level the instrument carefully.
  - Note the staff readings at Points A and B.
  - Calculate the difference between the readings.
  - Remove the level to point ‘D’ 3 m behind one of the pegs and set up.
  - Site the staff at A and B and note the readings.
  - Calculate the difference between the readings.
  - The difference between the readings al & bi and a2 & b2 should be the same if collimation is correct. If the differences are not the same then the instrument requires adjustment which should be carried out by an instrument engineer equipped for the job.

READING THE STAFF

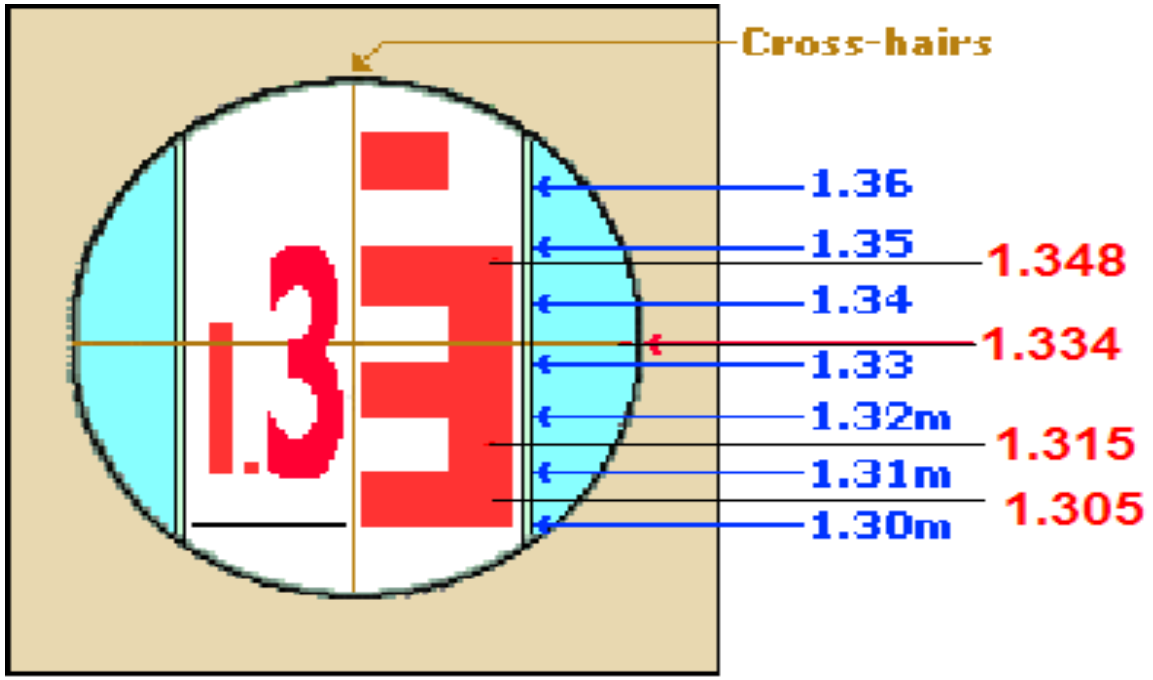
Prior to taking any reading from the staff, you should ensure that it is correctly extended.

- If this is not achieved, accuracy of readings will be adversely affected.

- To ensure the staff is being held vertically, a staff bubble is incorporated into most staffs.
  - The staff holder must ensure that the bubble is centred, thus ensuring the staff is vertical when it is being read by the observer.
- Change plates provide a stable point on which to hold the staff when levelling over soft ground.
  - They are also referred to as base plates.
  - The change plates are triangular metal plates with a domed centre and corners turned downwards.
- It is important to read the staff correctly to obtain accurate levelling results.
  - A common error is to mistakenly read the wrong crosshair when sighting through the eyepiece.
  - Above and below the main crosshair are shorter stadia crosshairs. It is important not to use these for reading levels.

LEVELLING METHOD

- Benchmark Levels
- Using Absolute Levels
- Using Relative Levels



TAKING A READING

The staff holder holds the staff on the mark and ensures that it is held vertically and facing the instrument.

- The observer directs the telescope on to the staff focuses the telescope and ensures that parallax has been eliminated.
- If a tilting level is being used, the main spirit level is now accurately centred.
- The dumpy and automatic levels will already be levelled.
- The observer must now remove his hands from the tripod and instrument

to prevent any tilting of the line of collimation which will result in a wrong reading being taken.

The meters and points of a meter are noted.

- The 10mm graduations are counted and the final millimetre placing is estimated.
- The complete reading is then booked.
- The spirit level is checked and the staff reading taken once more and checked against the booked figures.
- The staff holder is then directed to the next staff station where the reading procedure is repeated.
- There are many causes of inaccurate reading

RISE AND FALL METHOD

The rise and fall booking method is a table format for recording the various readings that are taken.

- Each reading is recorded in the order that it is sighted.
- The end result of this method is that you will have a column of information with a height reading (reduced level) that relates to other points on the job, so the difference between each point can easily be seen.

Some definitions need to be understood in order for you to use the rise and fall method.

- Station
- Backsight (B/S)
- Foresight (F/S)
- Intermediate Sight (I/S)
- Rise
- Fall
- Reduced level

SYSTEM OF REDUCTION-LEVELLING BETWEEN TWO POINTS

The time of collimation is the horizontal line of sight as viewed through a level telescope.

- When the telescope is rotated it will sweep out a horizontal plane known as the plane of collimation.
- Levelling between two points.

TRAVERSE

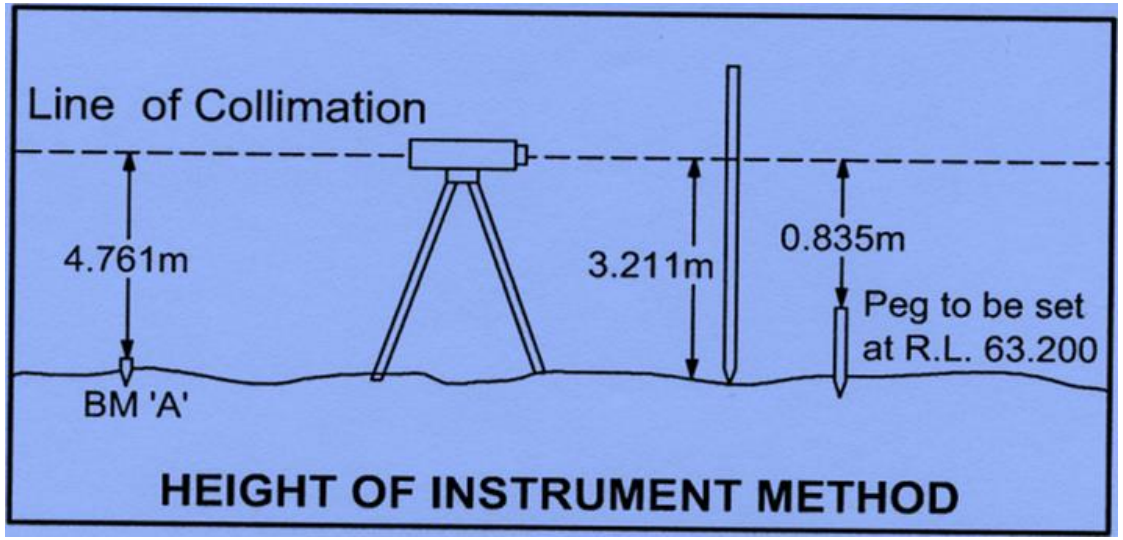
If it is necessary to level from a point of known reduced level, a benchmark or temporary benchmark for example, to a distant point, a series of levels will need to be carried out.

- This is referred to as a level traverse.
- Traverse Obstructions
- Carry Out Level Traverse

HEIGHT OF COLLIMATION/ HEIGHT OF INSTRUMENT METHOD

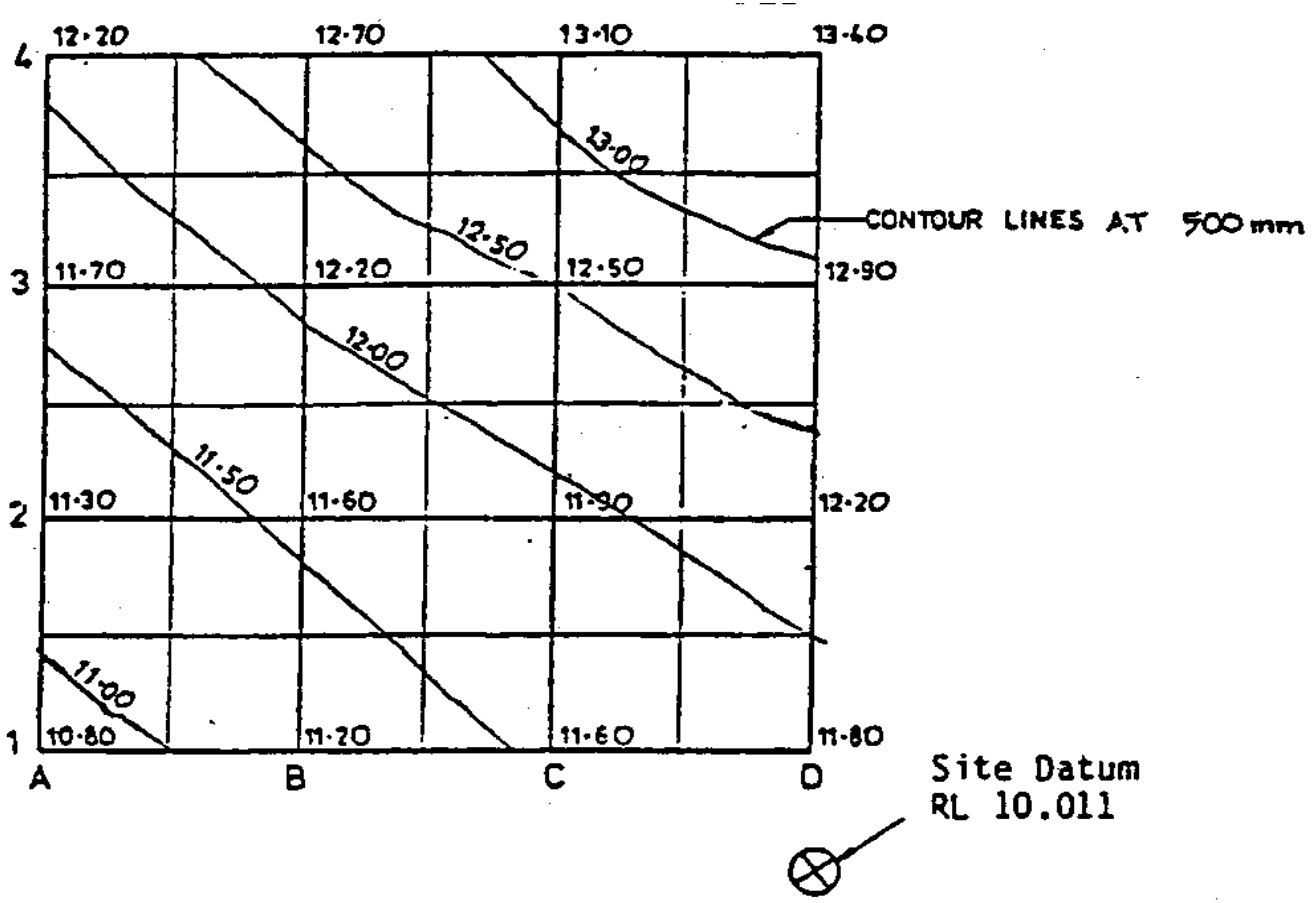
The height of collimation method provides an alternative means of reducing levels, and is very useful when it is necessary to set pegs or form work to a required level.

- The line of collimation is the line of horizontal sight.
- The level of this line can be easily determined by adding the staff reading
- on a benchmark of other known points to the level of that mark.



GRID WORK

This is the method most commonly used to take quick and efficient levels over a construction site.



GRID WORK

Method:

- The area to be levelled is measured off to a grid of convenient size squares for the purpose of taking a level shot at each intersection.
- The sides the squares may be from 3 to 10 metres, according to the degree of accuracy required.
- A drawing of the grid is made (as in figure 4) and as each reduced level is obtained it is recorded adjacent to the respective point on the thawing.
- Reference to each point is made by a letter and a number: e.g. the R.L. At B2 is 1 1.60.
- To lay out the grid, lines and tapes are used and a peg is driven at each point.

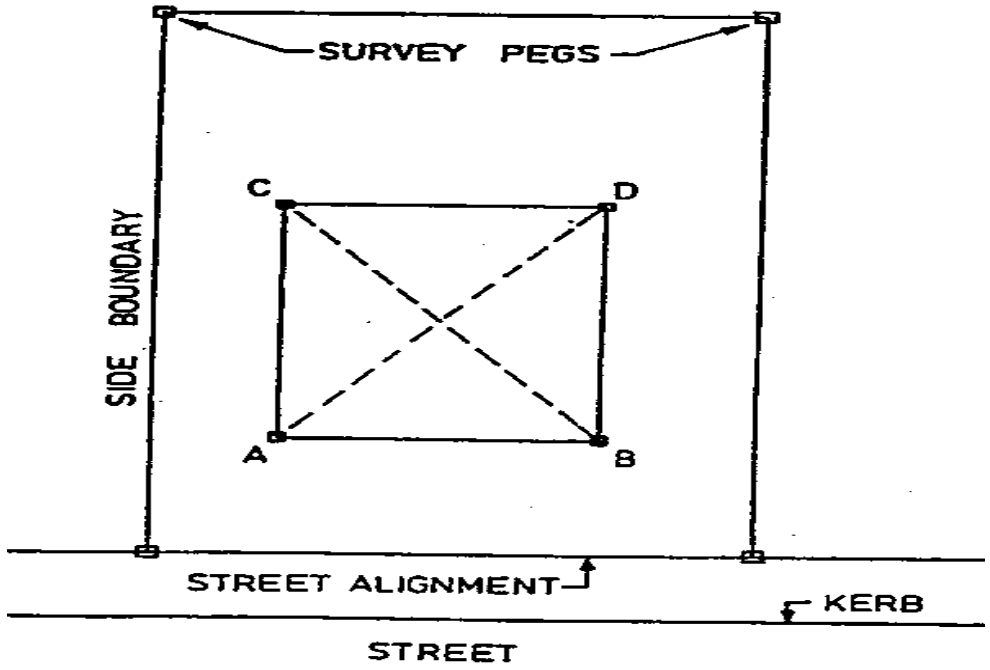
GRID WORK

The first staff reading (back sight) is made on the site datum, which in this example has an assumed reduced level (R.L.) of 10.00 metres.

- The actual reading on the staff viewed through the telescope may be for example 4.20 m.
- This means that the line of sight (collimation) is 4.20 m above the site datum, therefore, this line of collimation has an assumed height of 10.00 + 4.20 = 14.20 m.
- As each staff reading is taken at the various grid points, the individual readings obtained are subtracted from the line of collimation height in this case 14.20 m to give the R.L. of the grid points.

SET OUT POINTS

- Set out major rectangle.
- Set out a building (with offsets) on sloping ground, use of continuous profiles



PIPELAYING

The pipe laser is used to provide grade, elevation and line reference for the installation of storm, sewerage and other gravity flow pipes.

- The system can be used for tunnelling, boring, pipe jacking and other aligning applications requiring line and grade.
  - The laser produces a beam of laser light, projected in the same direction and at the same percent of grade as the pipe being placed.
  - The beam is intercepted by a target mounted in the pipe, on the pipe or on a pole.
  - The pipe layer positions the pipe until the laser beam strikes the centre of the target.
  - The system eliminates time consuming batterboards, stringlines and other methods of control.

Following are the general procedures for using the pipe laser:

- General set up; set grade of pipe into laser; set laser to proper elevation at start of pipe run; and align laser beam to next manhole.

CLEANING WORK AREA

Clear work area and dispose of or recycle materials in accordance with project environmental management plan.

Cleaning up correctly is just as important as any other task involved in construction. Cleaning up means all debris and waste materials must be collected and removed to the waste storage area and sorted for recycling. Unused materials must be cleaned and returned to the storage area and stacked or stored neatly. Report faults in logbook or site records. The work area must be left clean, safe and secure on completion of the task.

The construction process has particular environmental impacts and mitigation options at each level of work: site establishment and setup; construction work activities; and site restoration after the completion of work. To guard against these environmental impacts ensure that the Environmental Management Plan is adhered to when clean-up activities are undertaken.