Masonry

Level-II

Learning Guide-41

Unit of Competence: Apply basic leveling procedures

Module Title: Applying basic leveling procedures

LG Code: EIS MAS2 M09 LO1-LG-41

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LO-1: Plan and prepare

Instruction Sheet	Learning Guide #41

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Obtaining, confirming and applying work instructions.
- Following Safety (OHS) requirements
- Identifying and implementing signage/barricade requirements
- selecting tools and equipment to carry out leveling tasks
- Identifying environmental protection requirements

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Obtain, confirm and apply work instructions.
- Follow Safety (OHS) requirements
- Identify and implement signage/barricade requirements
- select tools and equipment to carry out leveling tasks
- Identify environmental protection requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 5.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5” in page 3, 13 ,20,23 and 32 respectively. .
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5” in page -12, 18, 22,30 and 33 respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “LO2 of this unit of competence

Information Sheet-1	Obtaining, confirming and applying work instructions

1.1.Introduction of Planning and preparing for work instructions/levelling.

work instructions is the Plan that inludes requirements and operational details of a relevant information to prepare for basic levelling activities. It may include plans, specifications, quality,working procedures.

As with all jobs in building and construction, the task of levelling requires careful planning and preparation – not only because it helps to get the task done efficiently, but it also ensures that it's done accurately and precisely. The levelling process helps creates a geographic profile of the site, so it's very important that this is carried out correctly. It's one of the very first steps in the building process, and all aspects of the construction rely on it. Mistakes made at this point will affect later stages of the construction process and can be very costly.

Later sections of this guide cover the actual processes involved in carrying out levelling operations. The things that must be considered before the process begins, such as:

-Work instructions and task requirements

-Your materials, tools and equipment

-Environmental requirements.

1.1 Safety on the worksite

Safety is the most important issue in all Construction tasks. All workers, no matter what task they're completing, must comply with all site safety Regulations and procedures.

You may think that carrying out leveling operations is low risk; however, it has some specific safety issues that you need to be aware of.

•**Movement around the site** – Constant moving around the site presents safety risks such as trip hazards, uneven or unstable ground. You also run the risk of bumping into obstacles.
•**Manual handling** – Although the equipment you use for leveling tasks is small and easy to transport, you may need to interact with other equipment and materials on a building site which are large, heavy and awkward to move.
•**Focus and concentration** – Because leveling requires you to focus and pay close attention to what you're doing to ensure you're being precise, it can be easy to lose awareness of your surroundings and what's happening around you.

•**Environment** – Leveling operations take place outside and often before any building structures are up to provide shade or shelter. You may be exposed to elements such as sun, wind and rain.

•**Dust** – The quality of the air on site may cause you respiratory problems and it can obstruct your vision while you're levelling.

•**Noise** – Building sites can be noisy at times, which may make it hard for you to concentrate. Noise is also a safety issue because you may not be able to hear what's happening around you.

•**Human traffic** – Building sites are often busy with lots of workers moving around. It's inevitable that people will get in each other's way sometimes.

•**Mechanical traffic** – There will be times when you'll be positioned in a place where you may not be seen easily seen by others – particularly if someone's driving a large vehicle. You may also have to take a level from a point on the kerb or roadside of the site, which puts you at risk from moving vehicles.

•**High-risk situations** – There are always areas of high risk such as demolition, excavation, confined spaces and heights that you'll need to be aware of. For example, you may be required to complete a levelling task for services and footings in an open trench.

1.2 Minimizing safety risks

As you know from the OHS unit you've already completed, the risk from safety hazards can usually be minimized if you take some basic precautions as part of your planning and preparation for the work task

1.3 Establishing the task

Before you start a leveling task, you'll need to

make sure that you've got all the information

required.

This information usually comes from the project plans, drawings and specifications. Interpreting these documents accurately is particularly important, because leveling must be very precise.

1.4 Work instructions

Work Instructions are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner. That is, describe, dictate or stipulate the steps that must be followed to correctly perform any specific activity or work.

A document describing specific activities and tasks within the organization. It contains the greatest amount of detail.

Whenever you're given instructions for a task or project, you'll need to make sure that you clearly understand what you have to do. Instructions may be provided in written or verbal form, or sometimes a mix of the two. Being able to give and receive instructions effectively is an important part of communication on the worksite. Here are a few tips to help you out if you're given instructions that are unclear or incomplete or if you have trouble understanding them.

Take notes. It's hard to remember everything by keeping it in your head. Writing a few notes helps remind you what needs to be done.

Ask questions. Don't be afraid to ask for more information or for clarification on something. Something simple like, 'I don't quite get what you mean by…' or 'Could you tell me a bit more about how to…' is a good way to get the details you need.

Be aware of language. You may be teamed up with people from other countries or cultures who don't speak English as well as you do. This can sometimes make communication difficult, but be patient. Listen carefully, speak clearly, take notes and ask questions until both you and the other person(s) are sure the instructions and/or information have been communicated correctly.

Confirm the instructions before you start the task. Never walk away feeling unsure about what you've got to do. A good way of confirming is to say something like, 'OK, before I go, I'll just check I've got this right…', then refer to your notes, run through the

key points or steps, and ask for confirmation that you've got all the information you need.

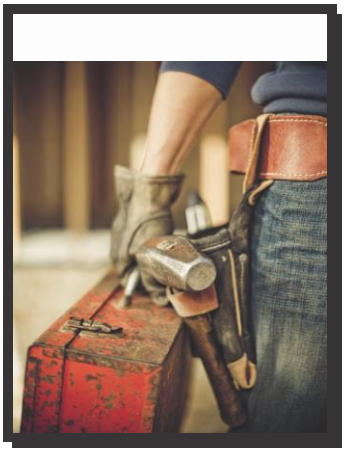
Sequence the instructions. Putting instructions and/or steps into the order you'll be completing them makes them much easier to follow.

1.5 Quality requirements

As with all construction tasks there are quality requirements related to carrying out leveling operations. These are generally covered in Standards. If you're unsure about quality requirements – whether in relation to the work you're doing, the materials you're using, or some other area
– always check with your supervisor.

Although there is no specific Standard for leveling, information related to carrying out leveling operations can be found in some of the Standards for construction elements that rely on correct establishment of ground level, such as: *Residential slabs and footings.*

1.6 Tools, equipment and materials



A very important part of planning for a construction project is being able to identify the tools that are most appropriate for the task and making sure you have access to them where and when you need them.

You'll be looking at the tools, materials and equipment used to carry out leveling operations in more detail later in this guide, but here are some key points you need to remember when

Planning and preparing for a work task.

-Check the condition of all tools before you start any work, and rectify or report any faults.

-Always read the manufacturers' instructions for any tools, equipment and materials you're not familiar with.

-Be aware of materials that may be hazardous. Look for warning labels and, if

there’s a safety data sheet (SDS), read it carefully.

-Never use a tool or piece of equipment for any purpose other than what it’s designed for.

-When you’re calculating material quantities, always double-check the plan and/or instructions you’re working from, and also your calculations. This will help you to avoid situations where you can’t complete a task because you have either too much or not enough of a material you need.

1.7 Environmental issues

All construction projects have the potential to affect the environment negatively. Although leveling tasks are generally considered to have very little environmental impact as they don't use resources heavily, create a lot of waste or require much clean-up, environmental issues still need to be considered.

Most construction companies or worksites will have an environmental management plan (EMP) or policies and procedures for ensuring that projects have as little impact as possible. It's everyone's responsibility to work in a way that has as low an impact on the environment as possible.

As part of your planning and preparation, make sure you:

• check if there's an existing EMP for the company, worksite and project

• comply with waste management and clean-up procedures as require

1.8 Purpose of Obtaining, confirming and applying work instructions

Every step of the work instructions process must be carefully documented. The documents and records kept serve several purposes. They;

- Provide evidence that the process was completed.
- Enable decisions or processes to be monitored and reviewed.
- Demonstrate accountability.

Enable accurate and consistent sharing of information

1.10.Sources of information for leveling activities

- **Diagrams or sketches**

A diagram is a symbolic representation of information using visualization techniques. Diagrams have been used since ancient times, but became more prevalent during the Enlightenment. Sometimes, the technique uses a three-dimensional visualization which is then projected onto a two-dimensional surface. The word graph is sometimes used as a synonym for diagram.

The term "diagram" in its commonly used sense can have a general or specific meaning:

1. Visual information device: Like the term "illustration", "diagram" is used as a collective term standing for the whole class of technical genres, including graphs, technical drawings and tables.
2. Specific kind of visual display : This is the genre that shows qualitative data with shapes that are connected by lines, arrows, or other visual links.

- **Manufacturer specifications and instructions**

Analysing technical information in an enterprise, including quality documentation, equipment manufacturer specifications, engineering data sheets and national standards. It also covers explaining and using the information, and identifying implications of changes to technical information.

Manufacturer specifications are an important element of cost and quality control for testing, calibration and other measurement processes. They are used for MTE (materials, tools and equipment) selection or establishing equipment substitutions for a given measurement application.

MTE specifications should provide adequate details about the expected performance characteristics of a representative group of identical devices or items (i.e., a specific manufacturer and model). This information should be reported in a logical format, using

consistent terms, abbreviations and units that clearly convey pertinent performance characteristics.

- **Maps**

Is the source of information to know the place where the task is being performed. A simple guide to creating a site plan that will meet your council planning department's requirements. Includes information on Scale, Format, Size and Examples.

- **Material safety data sheets (MSDS)**

  A Material Safety Data Sheet (MSDS) is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product. It is an essential starting point for the development of a complete health and safety program

- **Memos**

  A memo is a type of document used to communicate with others in the same organization. Memos (or memoranda) are typically used for fairly short messages of one page or less, but informal reports of several pages may also employ memo format.

- **Organization work specifications and requirements.**

It includes functional requirements, performance requirements, interface requirements, design requirements, and development standards. So the requirements specification is simply the requirements written down on paper

- **Signage**

Signage is the design or use of signs and symbols to communicate a message to a specific group. Signs are any kind of visual graphics created to display information to a particular audience. This is typically manifested in the form of way finding information in places such as streets or on the inside and outside buildings. Signs vary in form and size based on location and intent, from more expansive banners, billboards, and murals, to smaller street signs, street name signs, sandwich boards and lawn signs. Newer signs may also use digital or electronic displays.

- **Verbal or written and graphical instructions**

verbal instruction = instructions given verbally, or spoken words , can be heard

written instruction = instructions which can be read words and pictures need the ability to interpret

1. When you're giving instructions
   - ✓ **Think before you speak** - work out what you want to say before you say it, and make sure you cover all of the points that are relevant.
   - ✓ **Avoid jargon** - don't use words that the listener won't understand.
   - ✓ **Watch for body language signals** - see if the listener looks like they understand what you're saying.
   - ✓ **Ask for feedback** - check that the listener has understood the message the way you intended it.
2. When you're receiving instructions
   - ✓**Listen to the whole message** - don't assume you know what the speaker is going to say before they say it.
   - ✓**Use positive body language** - show that you're taking in what they're saying.
   - ✓**Ask questions** - clarify any points you don't understand.
   - ✓**Give feedback** - restate in your own words what you think the speaker is saying, and check that they agree with you.

- **Work bulletins**

Self-Check 1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the quality requirements?(3 points)
2. Write the resources of information to leveling activities? (3 points)
3. What are The things that must be considered before the leveling process/activities begins? (4 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____

   _____

2. _____

   _____

3. _____

   _____

Information Sheet-2	Following safety requirements

2.1 Introduction

Safety is the first essential requirement and every personnel must learn the safety measures even before he/she starts working on a machine or on equipments. Safety is an attitude, a form of mind of worker. If the attitude of worker towards safety is good and he/she is safety conscious, then he/she him/her self will develop the safe working habits. Before you can use equipment and tools or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.

- **Safety** is a precaution to avoid accident, right way of doing to avoid accident , follows direction to prevent wastage of time, energy & money
- **Care** is a technique of properly handling tools, equipments & materials.

To protect ourselves from the accidents of hand tools & machines in the workshop it's better to consider the following safety care and know safety sign.

2.1 classification of safety

safety can be classified as; personal safety(PPE & HSE), safety hand tools & equipment, safety working area, safety rules & regulation of in the construction site and first aid.(plaster, destinficant, bandage , ointment)

Fig.2.1.PersonalProtective Equipments

2.1.1 Personal safety(PPE & HSE).

The primary important to protect the work man from accidents is to identify possible

- Hazards and take the necessary safety measures to eliminate the hazardous. Before you go to work on any job, make sure your entire body is properly protected and provided other personal protective equipment and Healthy safety equipment.

Helmet; Protects the carrier from down falling items. t should be a must for everybody who works or moves on a building site

Ear protection; Protects the carrier from damages of the ears.

Safety shoes; Protects the workers feet from colds, chemical, and mud in the working area.

Safety glass; protects eye against chips and dust parking around from the work piece

Mask (resparatory equipment): Protects the worker from other endangering object and dust during construction.

Glove:-Protects the workers from oils, chemicals, and dust And other dangerous material that affect the skin**.**

2.1.2safety hand tools & equipments

- **Do not force the tool.** Use the correct tool for your application. The correct tool will do the job better and safer at the rate for which it is designed.
- **Do not use the power tool if the Power Switch does not turn it on or off.** Any tool that cannot be controlled with the Power Switch is dangerous and must be replaced.
- **Disconnect the Power Cord Plug from the power source before making any adjustments, changing accessories, or storing the tool.** Such preventive safety measures reduce the risk of starting the tool accidentally.
- **Store idle tools out of reach of children and other untrained persons.** Tools are dangerous in the hands of untrained users.
- **Maintain tools with care.** Keep cutting tools sharp and clean. Properly maintained tools with a sharp cutting edge are less likely to bind and are easier to control. Do not use a damaged tool. Tag damaged tools “Do not use” until repaired.
- **Check for misalignment or binding of moving parts, breakage of parts, and any other condition that may affect the tool’s operation.** If damaged, have the tool serviced before using. Many accidents are caused by poorly maintained tools.
- **Use only accessories that are recommended by the manufacturer for your model.** Accessories that may be suitable for one tool may become hazardous when used on another tool.

Accidents may take place due to human causes, environmental causes and mechanical causes. These causes are discussed as under**;**

- **Human Causes**

1. Accidents may occur while working on unsafe or dangerous equipments or machineries possessing rotating, reciprocating and moving parts.

2. Accidents occur while operating machines without knowledge, without safety precautions, without authority, without safety devices.

3. Accidents generally occur while operating or working at unsafe speed.

4. Accidents may occur while working for long duration of work, shift duty etc.

5. Accidents commonly occur during use of improper tools.

6. Accidents may occur while working with mental worries, ignorance, carelessness, nervousness, dreaming etc.

7. Accidents occur because of not using personal protective devices.

- **Environmental Causes**

1. Accidents may occur during working at improper temperature and humidity causes fatigue to the workers so chances of accidents increases with workers having fatigue.

2. The presence of dust fumes and smoke in the working area may causes accidents.

3. Poor housekeeping, congestion, blocked exits; bad plant layout etc. may cause accidents.

4. Accidents occur due to inadequate illumination.

- **Mechanical Causes**

1. Continued use of old, poor maintained or unsafe equipment may result in accidents.

2. Accidents commonly occur due to use of unguarded or improper guarded machines or equipments.

3. Unsafe processes, unsafe design and unsafe construction of building structure may lead to accidents in the plant.

4. Accidents occur due to improper material handling system and improper plant layout

5. Accidents may occur due to not using of safety devices such as helmets, goggles, gloves, masks etc.

2.1.3 safety working area

Working place or area is whole building/construction/ site including tools, equipment, machines, storerooms, etc. Within the general working place there is a personal working area /space/, where someone is building up a wall or other related activities. Working space is essentially required for all construction workers, to accommodate materials and equipments for the process; therefore, it is a crucial and necessary to keep them all in proper manner.

A neat and tidy site safes time, eases the work and avoids accidents. If things like tools, battens, boards, stones, cables, steel bars etc. are not used or kept improperly they are obstacles for the construction process and can be the cause for accident.

What does an accident mean?

Personally:

Consequences of the Accident may:-

- For short times

OR

In worst case

Dead

Worries for the family

- Permanent pain

OR

- Loss of salary so that financial deficiency for medical treatment & other expenses /unemployment/

Figure 2.2. accident result.

2.1.4 safety Rules and regulations.

- **General Safety Rule**

General safety rule is very important to reduce the accident while you working in workshop. Some of them are listed below,

- ✓ ***Follow directions*:-**understanding the procedures of using by hand tools & machines.
- ✓ **Stay alert.** Watch what you are doing, and use common sense when operating a power tool. Do not use a power tool while tired or under the influence of drugs, alcohol, or medication. A moment of inattention while operating power tools may result in serious personal injury.
- ✓ **Use safety equipment.** Always wear eye protection. Dust mask, non-skid safety shoes, hard hat, or hearing protection must be used for appropriate conditions.
- ✓ ***Always dress properly***: - Dress properly for your work. While you must wear your aprons are provided so that you can work on the machines. Remove any jeweler, neckties, chains, bracelets, and rings. Roll up your sleeves and tie any hair back in a ponytail before beginning any work
- ✓ ***Keep the shop clean: -*** Put your tools back where they belong when you finished.
- ✓ **Keep the floor clear of debris and sawdust:-** the floor should be clear of scrap blocks, excessive material, and sawdust. Keep projects, sawhorses, and other equipment and materials you are using out of travel lanes. Wipe up any spilled liquids immediately.
- ✓ ***Learn to use the tools correctly***
  - -Understanding using of hand tools in proper ways.
- ✓ ***Avoid house play***
- ✓ ***Report all accidents***
- ✓ ***Practice lending a cheerful helping hand when requested by someone.***

Be thoughtful and helpful toward other students in the class. Caution them if they are violating a safety rule. This is one of the most important rules in that all of you have responsibility for each other's safety and well-being in the class.

2.1.4.1 Firt aid;

A building site should have a first aid box which as minimum contents: -

Plasters;

Bandages;

Ointments;

Disinfectant.

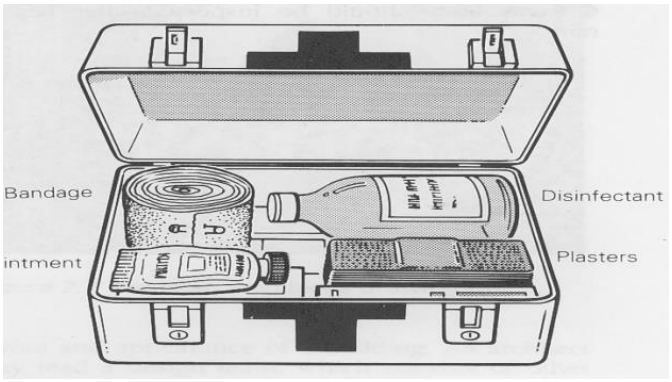


Fig 2.3 Firt aid

Self-Check 2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page.

1. What are Personal Protective Equipments?(2 points)

2. Mention causes of accidents. (3 points)

3. What are safety rules and regulation? (5 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____
   _____
2. _____
   _____
3. _____
   _____

Information Sheet-3	Identifying and implementing signage/barricade requirements

3.1 Introduction

Clear and effective traffic signs are essential for the efficient operation of the work network, for the enforcement of traffic regulations and for work safety. This Traffic Signs Manual provides details of the traffic signs which may be used in construction of levelling.

3.2 Purpose

Traffic Management Plan requires the applicant to prepare a Communication Plan Upon approval of the Traffic Management Plan. The Communication Plan will be enacted by the applicant prior to the commencement of construction, at which time project information shall be provided to all stakeholders.

3.3 Classification

- signs (including construction markings) are divided into three broad types:
  - ✓ **Informatory signs** - which give directions and distances to destinations or which provide other information that may be relevant to users;
  - ✓ **Regulatory signs**- which give instructions, prohibitions or restrictions which
    - users must obey.
  - ✓ **Warning signs**- which warn of hazards on the site ahead. Whenever possible during work;
- Regulatory signs are:
  - ✓ Mandatory,
  - ✓ Restrictive and

✓ Prohibitory,

- **Mandatory sign**s - it indicate that a site user must take a certain action: for example 'Keep Left'. They generally have white symbols on solid blue discs.

Fig 3.1 Mandatory sign

- **Stop** and **Yield signs** - special types of mandatory signs with distinctive shapes. It helps to stop the vehicles.

Fig 3.2 Stop or yield sign

- **Restrictive signs** -it indicate that a limit must not be exceeded: for example '50km/h' or 'Weight Limit 7.5t'. They have black symbols and text on a white disc with a red border;

sign

- **Prohibitory signs**- indicate something which must not be done: for example 'No Right Turn' or 'No Parking'. They generally have black symbols and text on a white disc with a red border and a red diagonal bar.

Fig 3.4 Prohibitory or regulatory sign

Self-Check 3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which one of the following traffic sign is give instruction or prohibition? (2 points)
   A. Warning
   B. Regulatory
   C. Information
2. Regulatory sign is always mandatory(2 points)
   A. True
   B. False
3. Write types of traffic sign? (3 points)
4. What is the purpose of mandatory sign? (3 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1_____

2 _____

3_____

4_____

Information Sheet-4	Selecting tools and equipment

Levelling tools

Depending on the task, levelling operations on a construction site are carried out using a variety of tools. Some of these tools are very simple and quick to use while others are more complicated and require greater control for precision levelling.

Spirit level

A spirit level consists of a body (generally made from aluminium) with an inset glass tube filled with a liquid that contains a bubble of air.
The position of the bubble in relation to permanent markings on the glass indicates whether a surface is plumb (vertical) or level (horizontal).

Line level

A line level is a miniature spirit level with a hook on each end to allow the instrument to be suspended on
a taut string line. It's used to transfer height levels from one point to another. Line levels are not very accurate and are used mostly used to, for example, check falls in concrete paths.

Water level

Due to the effects of gravity, still water is level, so a clear plastic tube filled with water is a very simple tool that can be used to transfer heights on a construction site from one point to another.

Water levels are particularly useful to quickly transfer height measurements from one room to another when there is no clear line of sight.

Stringline

A string line is one of the oldest and most basic hand tools used in building and construction. It's typically used in the setting out of buildings to create a straight line between two level points.

Plumb-bob

Plumb-bobs (also known as plumb lines) are heavy metal objects with a pointed tip attached to the end of a stringline. Using gravity, they accurately transfer points vertically, eg from ceiling to floor, and can be used to check that a surface is plumb (vertically straight). Plumb-bobs can be awkward to use in windy conditions.

Straight edge

Straight edges have a long, straight body made from wood or metal and can be used with spirit levels
to transfer levels over short distances. They are generally available in lengths of 1.5–4 m.

Boning rod

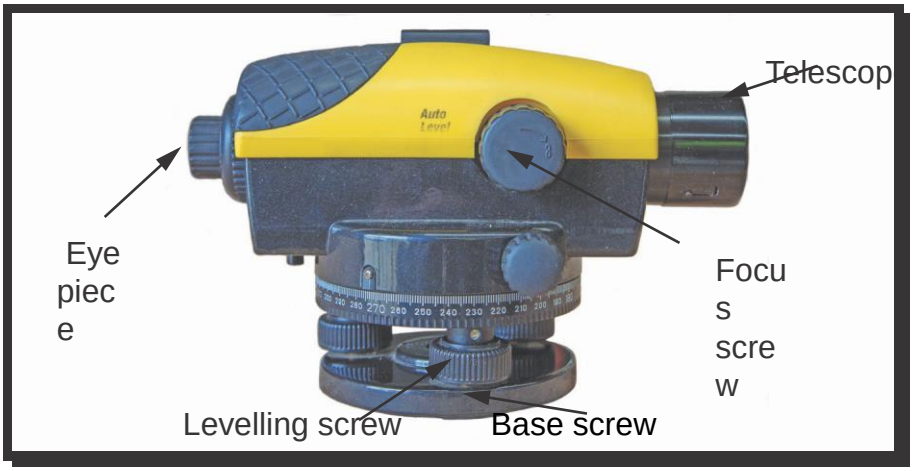
Boning rods are T-shaped devices used to check a straight line between two fixed points over long distances. They come in sets of three or four and are usually made from timber with their cross-rails painted in different colours – black, red and white – so that they can be seen easily.

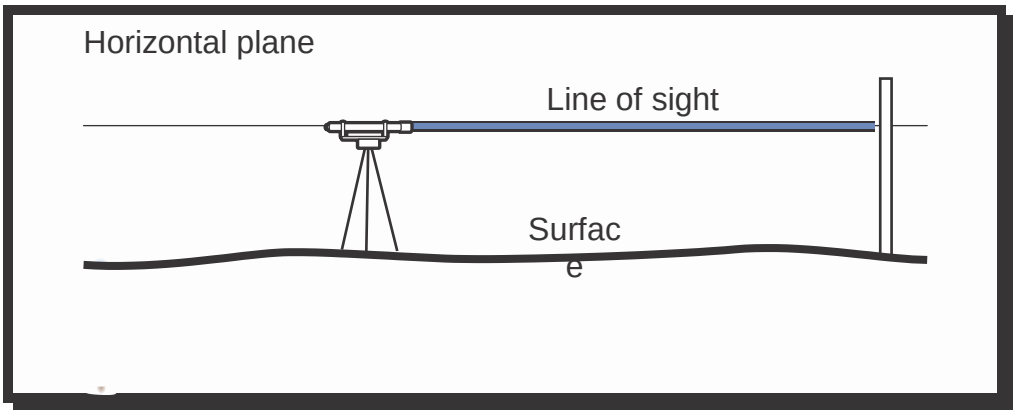
Boning rods are used to help in the setting out of horizontal surfaces or surfaces with a constant slope for excavation works, paths and drainage pipes.

Optical level

Optical levels are used to find precise height measurements and to check and transfer level information over longer distances than the simpler levelling tools described so far.

An optical level is basically a telescope (usually with a magnification of around 20×) mounted on a swivelling base. It's adjusted with an attached spirit level so that the view through the telescope (the line of sight) is straight along the horizontal plane.





By looking through the telescope toward a staff (a large rule), the operator can measure the distance between the surface and the line of sight. This measurement can then be compared to a measurement on a plan or at another location, or used to calculate the height of the surface at the position of the staff.

Optical levels are often referred to mistakenly as ‘dumpy levels’ which are only one of many types of optical levels. They include the following.

Dumpy level

A simple, compact device consisting of a telescope fixed to a levelling plate with three or four base plate adjustment screws that are used to level the instrument. When set up correctly, the dumpy level will remain level when rotated through 360°.

Tilting level

A variation on the dumpy level that is very accurate and used for top quality work. The telescope is levelled by a screw which tilts the telescope. It needs to be reset for each reading taken.

Automatic level

Also known as a ‘self-levelling level’, an automatic level requires only basic set-up as it has internal compensating mirrors that fine-tune the level of the instrument. Automatic levels are the most commonly used optical levels due to their speedy set-up time and ease of use.

Digital level

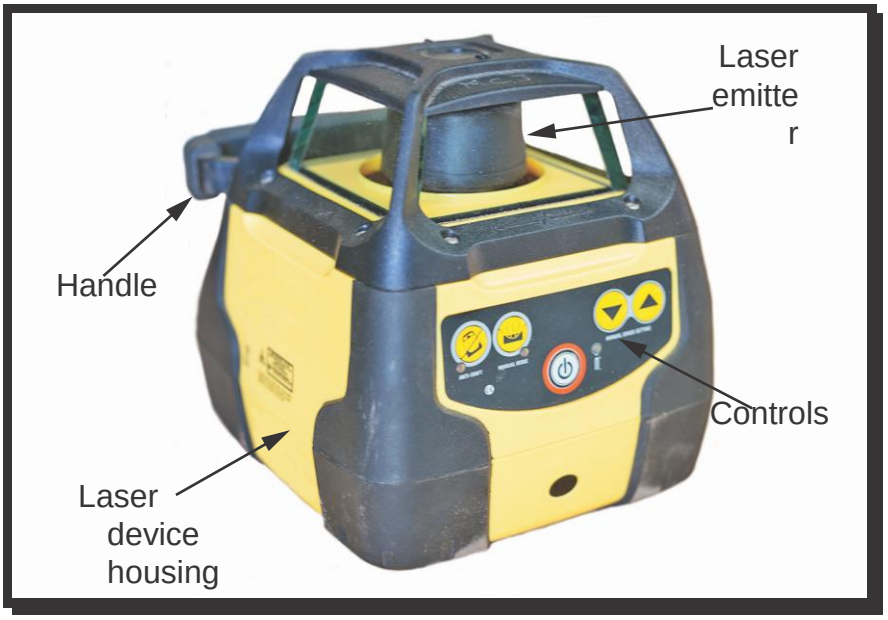
Similar to an automatic level; however, the readings are taken automatically by the instrument using a barcode. The instrument displays the reading and records the level measurements.

The advantage of optical levels over other simpler levelling tools is that they're accurate and quick to use over long distances. Because there are no physical media involved,eg stringlines, straight edges, they're relatively free from error – as long as the operator can read a staff correctly!

The main disadvantage is that they can't be used by a single operator as they require an assistant to position and hold the staff.

Laser level

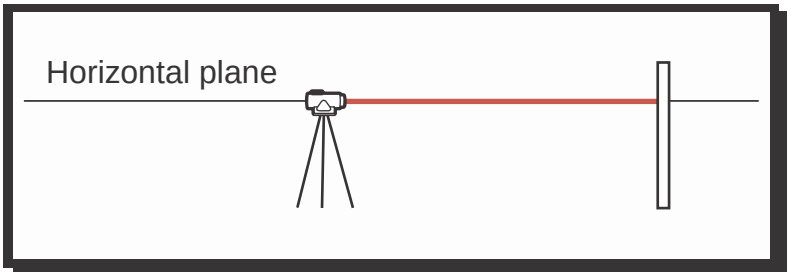
Laser levels are replacing optical levels on construction sites because they are more precise, easier to use and can be operated without an assistant.



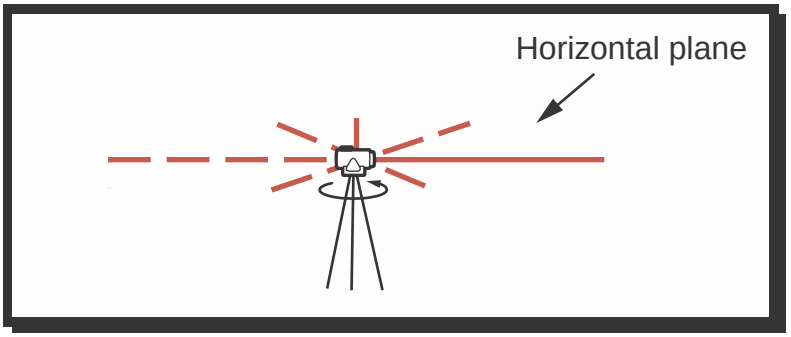
A laser level is a laser beam projector mounted on a tripod. It projects a beam of light along a horizontal plane. The light falls on a surface, eg a wall or a staff, and a mark, comparison or staff reading can be made.

The laser levels most commonly used in the construction industry include:

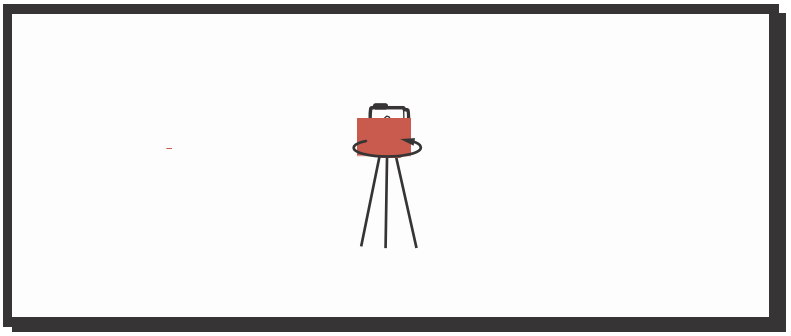
• **Aimable** – a stationary laser beam aimed at a target with a remote control handset



• **Rotating** – a rotating prism that sweeps the laser beam 360° around the horizontal plane; the speed of rotation can be varied from zero to very fast



• **Continuous plane** – the laser beam is reflected by an inverted cone and spreads a continuous plane of laser light through 360°.



Laser receiver

As the laser beam can't always be seen in brightly lit areas, a receiver (also known as a detector or target) is usually used to locate the beam.

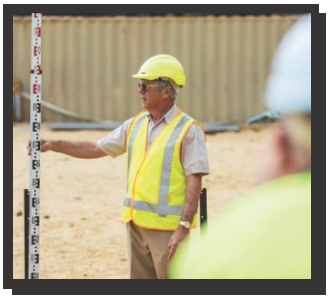
Classification of lasers

Any equipment that generates a laser is classified by an Australian Standard. Powerful lasers can cause injury (particularly eye damage) and can be used only by a licensed operator.

Most laser levels available for use in construction levelling, however, are very low-powered and classified as Class 1. These means that they're safe to use and an operating licence isn't required.

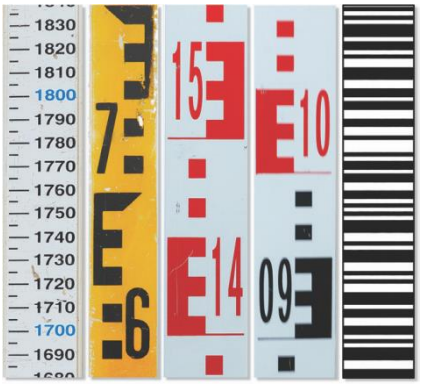
Some classifications of laser levels require the operator to display safety signs warning that laser levels are being used.

Levelling staff



Levelling staffs are long vertical rulers, usually made from wood or aluminium, which are marked with a graduated scale so that measurements can be at a distance. They're usually 3–5 m long and may have telescoping or hinged sections that expand or collapse as required.

Levelling staffs are available in a variety of measuring units,
scales, graduations and patterns, including barcoded staffs that are used with digital levelling equipment.

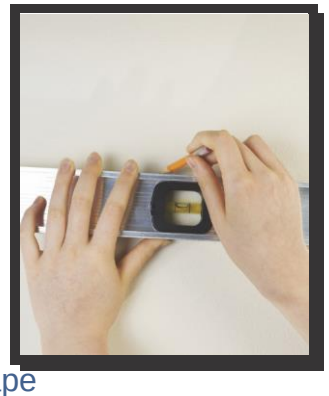


The most commonly seen levelling staff on construction sites in construction is the E-staff which has distinctive E-shaped markings.

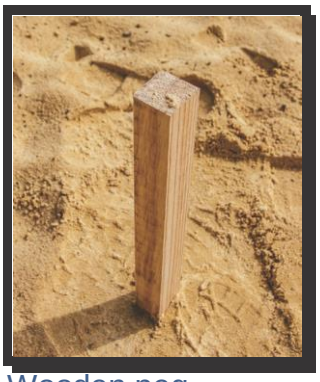
Miscellaneous equipment

Tripod

Measuring tape



Marking tool



Wooden peg

Steel peg

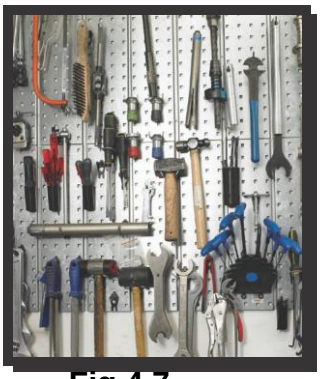


Fig 4.7.

1. **Equipment required for Leveling**

- **Laser levels** –is an optical **instrument** used to establish or verify points in the same horizontal plane and to measure height differences.

Fig 4.8. Laser levels

Self-Check 4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the purpose of laser levels? (4 points)
2. Which one of the following helps to measure distance or length? (2 points)
   A. String
   B. Peg
   C. Tape
   D. Sprite level
3. ----------is atools used to prepare peg for leveling set up. (2 points)
   A. Shovel
   B. Trowel
   C. Hand rammer
   D. Pick Axe

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1._____2._____

_____

3._____

Information Sheet -5	Identifying Environmental protection plans

5.1 Identifying and applying enviromental requirments.

All construction projects have the potential to affect the environment negatively. Although levelling tasks are generally considered to have very little environmental impact as they don't use resources heavily, create a lot of waste or require much clean-up, environmental issues still need to be considered.Most construction companies or worksites will have an environmental management plan (EMP) or policies and procedures for ensuring that projects have as little impact as possible. It's everyone's responsibility to work in a way that has as low an impact on the environment as possible. As part of your planning and preparation, make sure you:

- check if there's an existing EMP for the company, worksite and project
- comply with waste management and clean-up procedures as required.

Environmental issue	Strategies to address the issue
Excessive noise	Limit work to specified hours, use sound-dampening devices, redesign the work procedures to avoid high-noise equipment or tools, regularly check noisy equipment, limit vehicle traffic and site access.
Excessive dust	Keep the traffic area dampened, ensure loads to/from the site are fully covered, erect screens around high-dust areas, use dust collection devices.
Vibration	Place portable equipment or plant on pads, use alternative low-vibration equipment (including hand tools if necessary).
Waste management	Use filter traps for waste water, segregate and store waste, regularly collect and dispose of waste including off-site disposal or re-use and recycle.
Hazardous goods	Identify and segregate hazardous goods, provide secure storage areas, use MSDS to ensure correct handling/storage, limit quantities on-site, provide PPE and specific training.
Spills	Provide on-site spills kits, use bunding, have designated wash-down areas.
Soils	Store or remove contaminated or waste topsoil, use erosion management methods.

Self-Check 5	Written Test

Instructions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers. Write your answers in the sheet provided in the next page.

1.what is the of Enviromental Protections? (10 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

1. _____
_____

REFERENCE

Https://ginninderry.com/wp-content/uploads/2017/03/EPA-Guidelines-for Construction-and-Land-Development-ACCESS.pdf. Accessed on Oct 30/2017

-Https://en.wikipedia.org/wiki/Diagram

-Http://www.isgmax.com/Articles_Papers/Equipment%20Specs%20Paper.pdf

-Https://www.collate.co.nz › BU622-Good-plans-and-specifications

-Https://en.wikipedia.org/wiki/Signage

Masonry

Level-II

Learning Guide-42

Unit of Competence: Apply basic leveling procedures

Module Title: Applying basic leveling procedures

LG Code: EIS MAS2 M09 LO2-LG-42

TTLM Code: EIS MAS2 M09 TTLM 1019v1

LO-2:Set up and use leveling Device

Instruction Sheet	Learning Guide #42

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identifying heights or levels to be transferred/established

✓ levelling procedures

- setting-up and testing leveling devices
- Applying leveling staffs
- shooting levels and transferring heights
- Documenting results of leveling procedure.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Identify heights or levels to to be transferred/established
- leveling procedures
- set-up and testing leveling devices
- Apply leveling staffs
- shoot levels and transfer heights
- Document results of leveling procedure.

Learning Instructions:

2. Read the specific objectives of this Learning Guide.
3. Follow the instructions described below 2 to 7.
4. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5” in page -37, 49, 68,78 and 81 respectively.
5. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5” in page -48, 67, 75,80 and 85 respectively.
6. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3, Operation Sheet 4 and Operation Sheet 5 ” in page -86,87,87,89 and 90 respectively.
7. Do the “LAP test 1” in page – 91 (if you are ready).

Information sheet-1	Identifying heights or levels to be transferred/established

1.1 Introduction to heights orlevelling

Levelling is the process of identifying the heights of points on a surface by taking and comparing measurements. It's possible to discover the height of a mountain with the correct levelling technique.

Identifying elevations (heights) is essential in the construction industry to create or profile the surfaces required when building stable, safe and economical structures of all types including roads, bridges, mines, dams and commercial, community and residential buildings. In this section we'll look at:

- What levels are
- How levelling is used in building and construction
- leveling methods
- leveling tools.

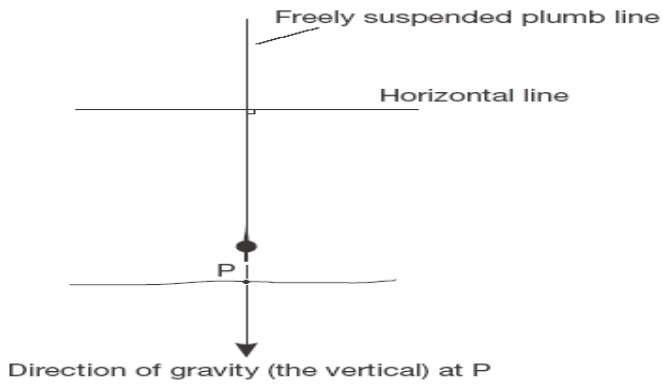
Earth. It is the process of measuring heights. It is possible when leveling to measure heights with an accuracy of millimeters Heights can also be measured using total stations, handheld lasers and GPS devices.

However, leveling offers an inexpensive, simple and accurate method for measuring heights, and it is widely used in construction sites. Any method of measuring the heights of points above or below the ground using an agreed datum.

level is a measurement of the elevation (height) of a point above or below another point, eg the height of the floor of a building above ground or the depth of a sewerage drain below ground.

This datum's or reference points are present in all construction sites and has an arbitrary height assigned to the point. Most construction sites will have several of these benchmarks, and if they have heights based on an arbitrary datum, they are known as Temporary Bench Marks.

- **Heights** are defined using horizontal and vertical lines.The figure below shows a plumb- bob suspended at point P, the direction of gravity along the plumb-line defines the vertical at point P. A horizontal or level line is any line at right angles to this



For site work, any horizontal line can be chosen as a datum for heights and for leveling. The height of a point is measured along the vertical above or below the chosen datum.

Fig 1.2 plumb- bob suspended to check verticality

The height of a point relative to a datum is known as its reduced level (RL).On most construction sites there is a permanent datum. The horizontal line or surface passing through this, with its height, becomes the leveling datum. The height of the datum can be arbitrary; a value often used for this is 100.000m. This is chosen to avoid any negative heights occurring. Any reference point on site which has had a height assigned to it is known as a bench mark. For most surveys and construction work, several bench marks would normally be established by leveling from the datum. If heights are based on an arbitrary datum these are known as Temporary Bench Marks or TBM

1.1. Leveling Terminology

Geoid; is a surface coinciding with mean sea level in the oceans, and lying under the land.

Level surface; is a curved surface that at every point is perpendicular to the plumb line.

Level line; is a line in a level surface, therefore a curved line.

Mean Sea Level (MSL): is the average height of the sea's surface for all stages of the tide over a 19 year period.

Datum: is a level surface to which elevations are referred (for instance mean sea level).

Elevation is the vertical distance from a datum (usually mean sea-level) to a point or object.

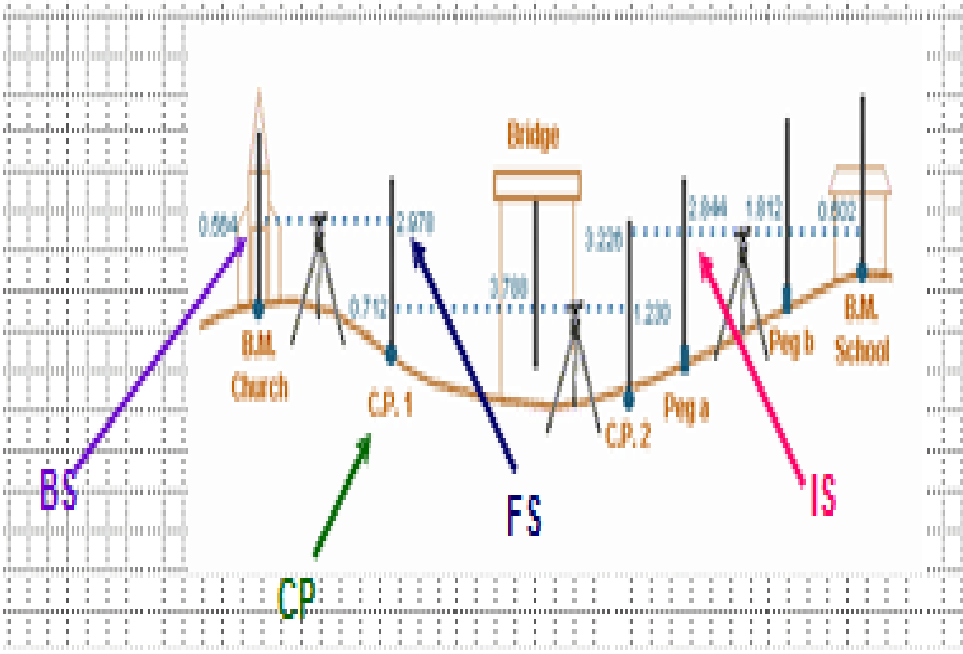


Fig.1.3 sample terms figure

Bench Mark (BM) is a relatively permanent object, natural or artificial, having a marked point whose elevations above or below an adopted datum is known or assumed (metal disks set in concrete, large rocks, non movable parts of fire hydrants, and curbs.

Backsight (BS) – 1st sight taken after the level has been set up. It is also a sight taken to a point whose height above HKPD is known

Foresight (FS) – last sight taken before moving the level. It is also a sight taken to a point whose height is required to carry on the line of levels

Intermediate Sight (IS) – other staff readings taken between BS and FS

Change Point (CP) – the staff position at which a FS and then a BS readings are taken

Reduced level (R.L):- it is the height of points stated with reference to the selected datum for the work in hand.

Instrument station:- is the place where the instrument is set up for observation.

Staff station:- is the place where the leveling is held vertically.

Height of collimation:- is defined as the vertical distance from the datum to the line of sight.

Turning point.(T.P):- is the station where a back sight and Foresight readings are taken. It indicates the shifting of Instrument.

Level- is an instrument used to take readings on a staff.

Leveling- is the process of determining the elevations of Points.

1.2. Uses of Leveling

In the context of measurements, leveling is used for the following purposes:

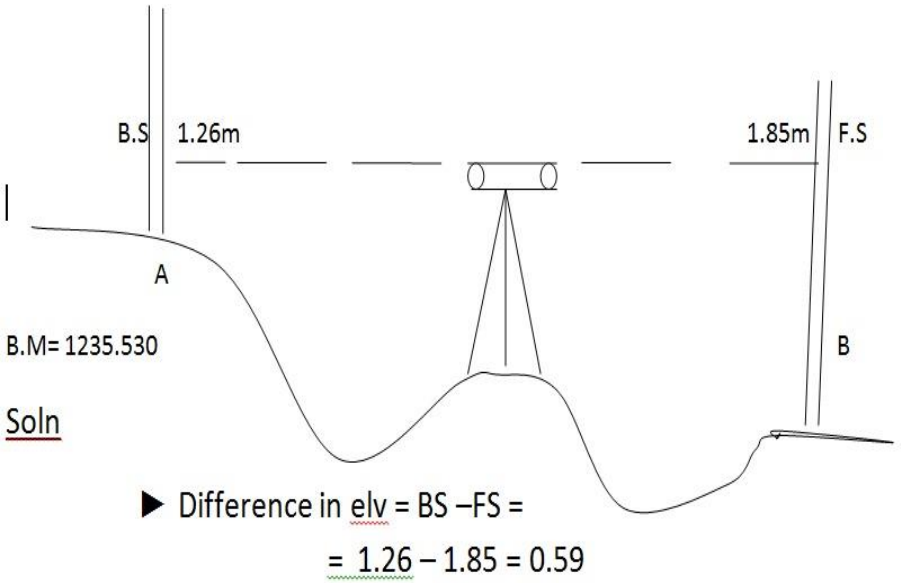
- **Referencing of Points:** To determine and check the vertical stability of the points with respect to reference points (benchmarks) in its immediate vicinity.
- **Connection to GPS Reference Points:** To determine its regional stability and to separate sea level rise from vertical crustal motion, the point should be connected via GPS to reference stations fixed in a global co-ordinate system.
- **Connection to National Leveling Network:** Mean sea level is used to define vertical datums for national surveying and mapping , hence the point must be connected to the national levelling network. Connection to the network will also allow all points to be connected to each other, providing information on spatial variations in mean sea level.

1.3. Leveling purpose

To provide heights or contours on a plan, to provide data for road cross-sections or volumes of earthworks, or to provide a level or inclined surface in the setting out of construction works and that are;

- Knowing the topography of an area,
- In the design of highways, railways, cannels, sewers, etc.
- Locating the gradient lines for drainage characteristics of an area,
- Laying out construction projects, and Calculating volume of earth work, reservoir etc.

Example



▶ Elv of B = elv of A ± (HA-HB)

= 1235.53 – 0.59

= **1234.940m**

▶ Check

☞ BS – FS = Last Rl –first Rl

☞ 1.26 – 1.85 =1234.94 -1235.53

☞ **0.59** = **0.59**

1.4 Types of Leveling

There are different types leveling. But in our context we use;

1.4.1 **Geometric Levelling** : In geometric leveling the difference of height between two points is determined by differences of readings to the leveling rod placed on those points. The readings are made with a leveling instrument.

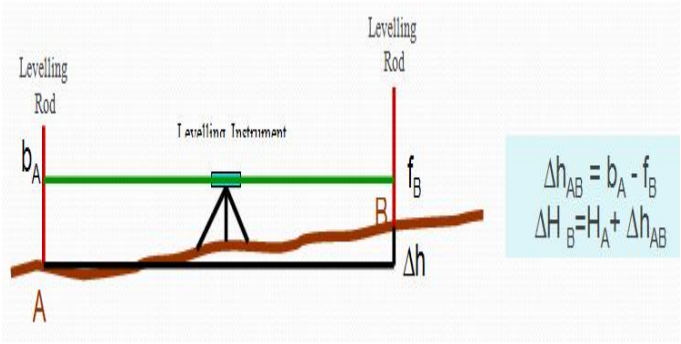
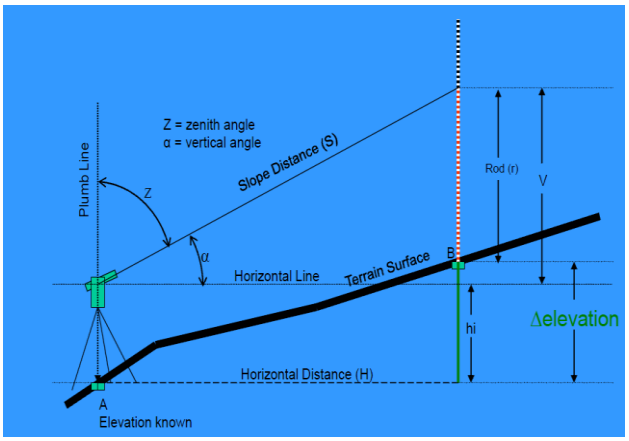


Fig. 1.7 geometric leveling

1.4.2**Trigonometric Leveling :** The difference in elevation between two points is determined by measuring distance (slope or horizontal) and vertical angle.



$$V = S \times \sin\alpha \text{ or } V = H \times \cot z$$

$$\Delta\text{elevation} + r = hi + V$$

$$\Delta\text{elevation} = hi + V - r$$

$$H_B = H_A + hi + V - r$$

Fig. 1.7.1 Trigonometric leveling

1.4.1 **Precise Levelling :** is a particularly accurate method of geometric levelling which uses highly accurate levels and with a more rigorous observing procedure than general engineering levelling.

In precise levelling we aim to achieve high orders of accuracy such as 1 mm per 1 km traverse.

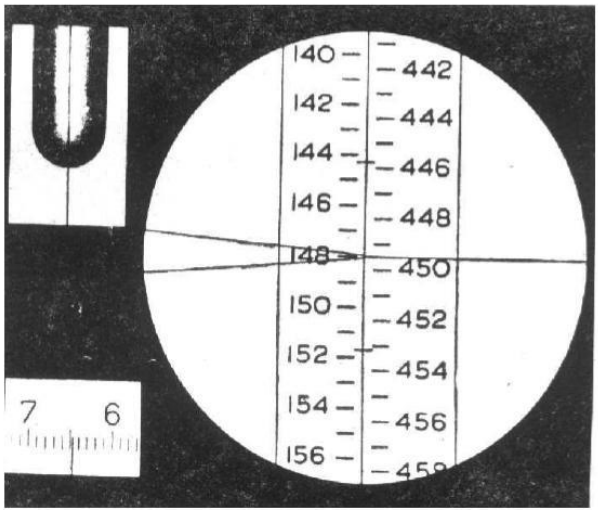


Fig. 1.7.3 Invar rod reading (1.48647)

1.4. Methods of leveling

A variety of leveling methods are used for different purposes. They include:

profile levelling, which involves taking a series of levels along a line, eg when constructing a road
reciprocal levelling, used to determine the levels of two points across an obstruction like a river or chasm by taking measurements from both sides
trigonometric leveling or calculating angles and distance to determine levels when, for example, one point is inaccessible. On a building site, levels are identified by comparing them to other levels or to a datum.

Simple leveling simple leveling is taking or comparing the levels of two or more points from a single location. It is usually done over relatively short distances.

Simple leveling would be used to, for example, set pegs at a uniform height for a concrete pour (so that a foundation or floor slab will be level) or to ensure that a brick wall remains straight and plumb as it's being built.

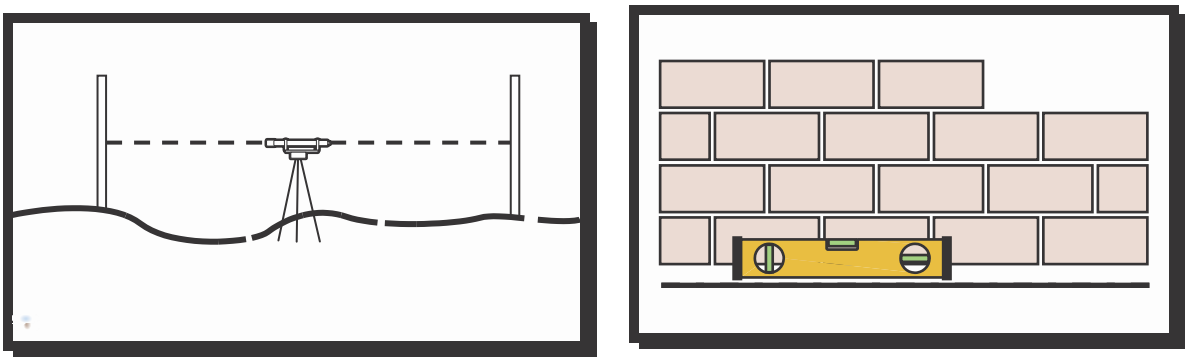


Fig.1.4 simple leveling

- **Differential leveling**

Sometimes it's not possible to take all the required level measurements from a single point. This can happen when:

- the points are too far apart
- the difference in height between the two points is too great
- there are obstacles obstructing the view between the two points.

Differential leveling is taking levels from different locations and calculating the relationships between the measurements and a datum.

Differential leveling may be used, for example, to take levels around the boundary of a building block, or to transfer a datum or benchmark from one side of the site to the other where there is a significant slope, a structure or natural feature in the way.

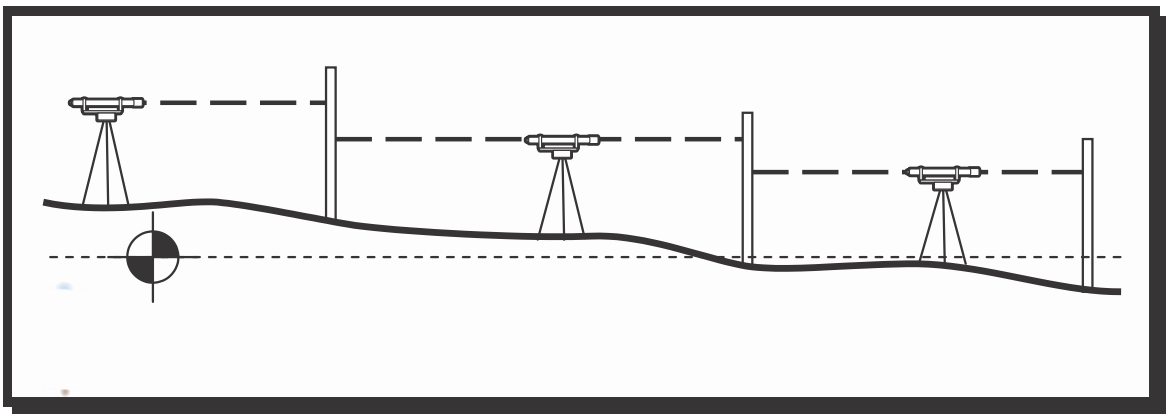


Figure:1.5 .differencial leveling

1.4 Basic Rules for Leveling

- Always start and finish a leveling run on a Benchmark (BM or TGBM) and close the loops
- Keep fore sight and back sight distances as equal as possible
- Keep lines of sight short (normally < 50m)
- Never read below 0.5m on a staff (refraction)
- Use stable, well defined change points
- Beware of shadowing effects and crossing waters

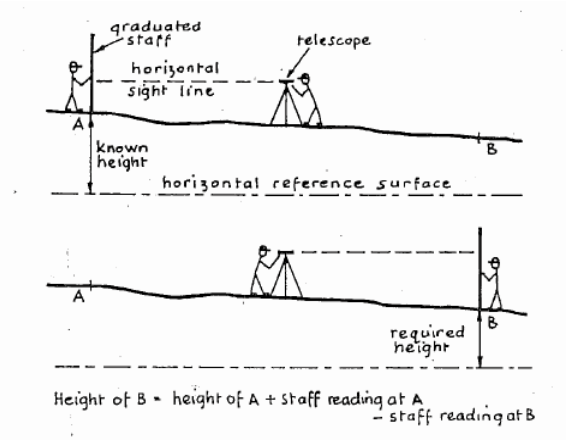
1.5. Leveling Procedures

- **Setting up**

✓ Back sight and foresight distances should be approximately equal to avoid any errors due to collimation, refraction or earth curvature.

✓ Distances must not be so great as to not be able to read the graduations accurately.

✓ The points to be observed must be below the level of the instrument, but not lower than the height of the staff. And;



1. The instrument must be check before use!
2. The instrument and level must be stable settled-up
3. The bubble tube must be leveled before the
4. reading

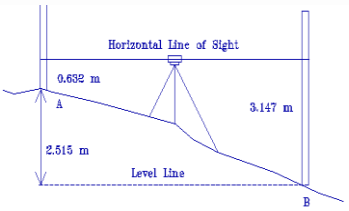


Fig.1.6 saple setting up leveling

- Beware of sun exposure (will wander)
- Ensure the instruments pendulum is in-limit

5. The instrument must be set up in the middle between two staffs
   - Prevents curvature effects
   - If impossible, use the same distances, but opposite for the next readings
6. You must not use the parallax screw between the back sight and foresight readings
7. Readings must be taken 30-50 cm above the ground

   - Surface refractions
   - Beware also of temperature gradients (inside/outside buildings)

8. Staff should be set up vertically
9. A change plate should be used
10. Leveling must be done in two opposite directions but the same line (beware of gravity gradients)
11. Staff should be calibrated

12. Be careful when crossing rivers (large water surfaces)

- Use “same-time” (mutual) observations
- Repeat it during different times of the day

- **Elimination of parallax**

✓Parallax is the apparent movement of the image produced by movement of the observer's eye at the eyepiece.

✓It is eliminated by focusing the telescope on infinity and then adjusting the eyepiece until the cross-hairs appear in sharp focus. The setting will remain constant for a particular observer's eye.

- **Booking**

✓ Level books or loose-leaf leveling sheets shall be numbered and indexed in a register.
✓ Details of the site, work, date, observer, chainman, booker, weather, wind, instrument and any other relevant items shall be entered.
✓ Enter the first observation (which is on a known point) in the back sight column, and sufficient detail in the remarks column to identify it. Enter the point's reduced level zero from the site register or plate on the Bench mark, etc.
✓ Enter all other points on subsequent lines as intermediates except the point chosen as the foresight. Identify them in the remarks column as above. Enter the foresight on a further line in the foresight column.
✓ Change the instrument to the next setup. Enter the following backsight on the same line as the previous foresight but in the backsight column.
✓ Repeat the above procedure at each setup on the outward run then reverse it to work back to the starting point on the return run. The furthest point out is treated as for all other change points.

Self-Check 1	Written Test

Directions I: **Say True or False** Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Reduced levels are relative permanent and fixed reference point of known elevation and after elevation are determined from it.
2. Elevation is the vertical distance from a datum to a point.
3. Bench mark is relative permanent and fixed reference point of known elevation and after elevation is determined from it.
4. Turning point is the station or point where both foresight and back sight readings are taken it denotes the shifting of the instrument.
5. What are leveling procedures?(5points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

4. _____
5. _____
6. _____
7. _____
8. _____

Information sheet-2	setting-up and testing leveling devices

2.1. Concepts of setting-up and testing leveling devices

All but the most basic leveling tasks will require the use of an optical or laser level to take precise level measurements of locations on the building site.

In this section you'll find information about:

- the process of setting up an optical or laser level
- taking a reading using a staff
- the types of errors that may affect the accuracy of leveling operations.

The first step in setting up the level is to attach the level itself to the tripod or legs. The level is placed in a location which is fairly open so that a clear rod reading may be obtained on the benchmark. The proper setting of the tripod is very important. The legs of the tripod are required to be spread so that the base plate of the level is approximately horizontal and a stable base is provided. If the ground has a steep slope, two of the legs should be set about the same elevation and lower on the slope than the third leg. The legs are set firmly into the ground and the three wing nuts of the legs just under the head tightened. The tripod is not set on a hard slick surface, such as a hot mix asphalt pavement, concrete pavement, or sidewalk, unless absolutely necessary.

2.2. Types of leveling devices

Most common leveling instrument today is the Automatic or Self-leveling level – has an internal compensator that automatically provides a horizontal line of sight and maintains this through gravity (prism hanging on pendulum)Instruments for Leveling: Basically there are different types of levels; namely -Dimply level- Tilting level- Automatic level & - Digital level. Generally there are Four basic level types are available: optical, automatic, electronic, and laser.

2.2.1 Optical level: An optical level is used to project a line of sight that is at a 90 degree angle to the direction of gravity. Both types, dumpy and tilting, use a precision leveling vial to . Orient to gravity. The dumpy type was used primarily in the United States, while the tilting type was of European origin and used in the remainder of the world. The dumpy level has the leveling vial fixed to the telescope, which is fixed at 90 degrees to a Rota table vertical spindle. Leveling screws, attached to the spindle, are used to center the leveling vial.

2.2.2 Automatic level: Automatic levels use a pendulum device, in place of the precision vial, for relating to gravity. The pendulum mechanism is called a compensator. The pendulum has a prism or mirror, as part of the telescope, which is precisely positioned by gravity. The pendulum is attached to the telescope by using precision bearings or wires (metallic or nonmetallic). Leveling screws are used to roughly center a circular vial, and the optics on the pendulum then correct the line of sight through the telescope. Finally, Roughly leveled using a circular spirit level, then internal mechanisms take over to make sure the level remains level and maintains a horizontal sight. They are very popular, quick to set up and easy to use.

1. Focusing screw
2. Eyepiece
3. Foot screw

6. Tangent screw
7. Circular bubble

Fig.2.2 Automatic level with parts name

4. Horizontal circle

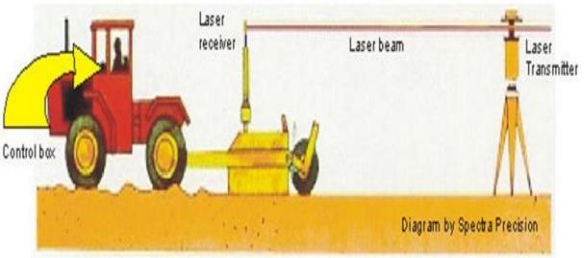
5. Base plate

8. Collimator (sight)

9. Object lens

2.2.3 Electr

onic level: This type of instrument has a compensator similar to that on an automatic level, but the graduated leveling stall is not observed and read by the operator. The operator has only to point the instrument at a bar-code-type staff, which then can be read by the level itself. The electronic level eliminates human reading error and increases the speed at which leveling work can be performed. The only significant disadvantage is the high cost as compared to the optical automatic level.



2.2.4 Laser level: Although this type of instrument is categorized as laser, these levels actually employ three different types of light sources: tube laser, infrared diode, and laser diode.

The instrument uses a rotating head to project the laser beam in a level 360 degree plane. The advantages are twofold: no operator is required once the instrument is set up; and different people in various locations can work by using a single light source. The disadvantages are that accuracy is less than that provided by other types of levels and that the cost is significantly higher.

- ✓ **Operating Laser levels**

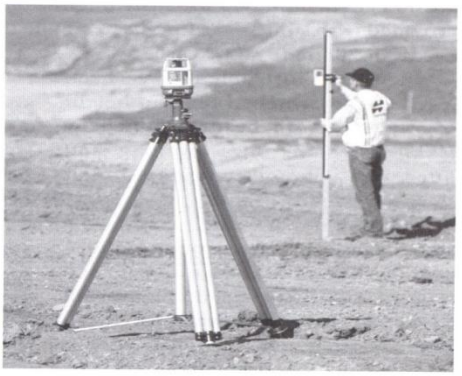
  Land Leveling through Laser Leveler is one such proven technology that is highly useful in conservation of irrigation water.

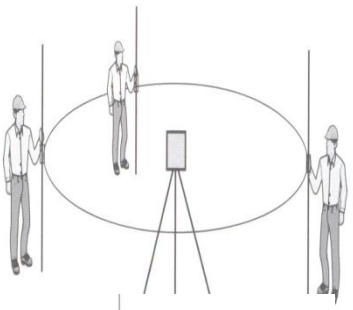
- ✓ **Laser Guided Land Leveling**

As per studies, a significant (20-25%) amount of irrigation water is lost during its application at the farm due to poor farm designing and unevenness of the fields. This problem is more pronounced in the case of rice fields. Fields that are not level, have uneven crop stands, increased weed burden and uneven maturing of crops. All these factors lead to reduced yield & poor grain quality.

Laser land leveling is leveling the field within certain degree of desired slope using a guided laser beam throughout the field. Unevenness of the soil surface has a significant impact on the germination, stand and yield of crops. Farmers also recognize this and therefore devote considerable time resources in leveling their fields properly. However, traditional methods of leveling land are cumbersome, time consuming as well as expensive

- ✓ **Rotary laser level**
- ✓ A rotary laser level is a more advanced laser level in that it spins the beam of light fast enough to give the effect of a complete 360 degree horizontal or vertical plane, thus illuminating not just a fixed line, but a horizontal plane. Laser levels contain a rotating laser which defines a visible horizontal





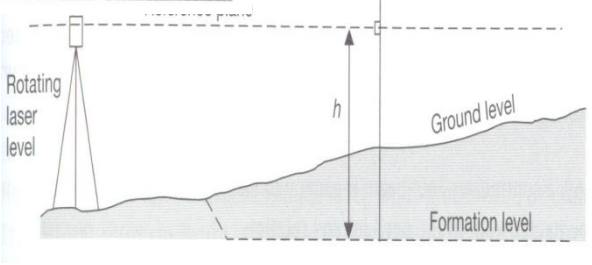


Fig 2.3 Rotary laser level

plane from which distance to the ground can be made and then the height can be determined

The laser beam projector employs a rotating head with a mirror for sweeping the laser beam about a vertical axis. If the mirror is not self-leveling, it is provided with visually readable level vials and manually adjustable screws for orienting the projector. A staff carried by the operator is equipped with a movable sensor, which can detect the laser beam and gives a signal when the sensor is in line with the beam (usually an audible beep). The position of the sensor on the graduated staff, also known as a grade rod, or story pole, allows comparison of elevations between different points on the terrain. Most laser levels are used in the construction industry..

- ✓ **Tower-mounted laser level** A tower-mounted laser level is used in combination with a sensor on a wheel tractor-scraper in the process of land laser leveling to bring land (for example, an agricultural field) to near-flatness with a slight grade for drainage.
- ✓ **Benefits**

  - For better distribution of water
  - For water savings (reduces the amount of water required for irrigation)
  - For Improvement in nutrient use efficiencies
  - Option for Precision Farming
  - Higher crop productivity
  - Reduces weed problems
  - Energy saving

2.2.5 Leveling Rods: Can be made of wood, metal, or fiberglass Graduated in meters. Rod levels are used to make sure that the rod is held vertical when making a reading.

2.3 Care of equipment

- Ensure that tripod screws and hinges are kept tight.
- Always transport the level in a padded box.
- When removing from the box lift it by the center and not by the eyepiece or objective end of the telescope.
- Screw it firmly onto the tripod, whilst holding it in one hand (make certain that it is not cross-threaded and that threads are compatible).
- When carrying the level tripod assembly in the field, support it over the shoulder or, in bush, crooked over an arm with the telescope unclamped (i.e. free to

rotate).

- Automatic levels should not be carried in a vertical or near-vertical position, as the compensator will swing about and be prone to damage.
- Staves are too much of a precision item of equipment to be used in place of a slasher, vaulting pole, etc.
- Staves shall be transported in their protective cases to protect the face from damage.
- Wooden staves which become wet should be dismantled and dried out before storing away.
- Any moisture which is evident in an instrument must be allowed to disperse by storing the level out of its case in a warm room. Should it persist after several days the instrument may require specialist servicing?

2.3. Setting up procedures the leveling instruments.

A tripod is used as a stable platform to hold the levelling device. To correctly set up and stabilise a tripod, consider the following tips.

- Do not position the tripod legs too far apart or too close together.
- On sloping ground, set the tripod so that one leg is uphill and the other two are downhill on the slope.
- Set up on firm, dry ground that doesn't shift as you walk around.
- Push the tripod's pins into the ground as far as they will go.
- Extend the legs on the tripod so that the tripod is just above chest height (the levelling instrument should be at eye height) as bending down or standing on tiptoe can be tiring.
- Set the top of the tripod as level as possible with the leg adjustment. This will minimise the adjusting that needs to be done with the base plate, adjusting screws or compensating devices and the amount that an automatic or laser level will need to correct itself. And The first step in leveling is to spread the tripod leg, used to support the head part, so that the tripod head is approximately horizontal, the legs should be far enough and they should be pushed to the ground to make the level sable. The next step is to center the bubble by the help of foot screws, latly targeting & Focusing.I.e

Spread the tripod ⟶ Center the inst ⟶ Targeting ⟶ Focusing.

Once the level is set up its important that the line of sight is horizontal. When the foot screws have been used to centralise the circular bubble, it is assumed that the compensator has set the line of sight to be horizontal.

However, most levels are not in perfect adjustment and when levelled their line of sight is never exactly horizontal.

If the line of sight is not horizontal when the instrument has been levelled, the level has a collimation error.

Think about where you're setting up. You may need to leave the instrument there for several hours or even all day. Will it be in the way of vehicles, other workers or members of the public?

Example;

Using an optical level

As an optical level is a very simple instrument, there is little difference in the way the various types are used to take a measurement. However, there are variations in the process of setting up and adjusting the instrument for accuracy.

The following information relates to the simple, automatic levels commonly used in building and construction.

Setting up

1. Mount the leveling instrument on the tripod and, if necessary, make manual adjustments to ensure that it's level.

a) Use the base plate adjustment screws to bring the bubble in the attached spirit level into the centre.

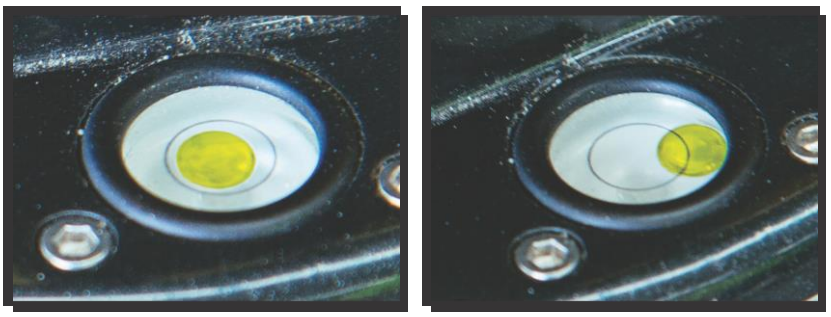


Fig 2.4. the bubble in the attached spirit level into the centre

b) Swing the optical level around 180° and center the bubble again.

c) Return the optical level to the starting position and recheck the bubble. Adjust as necessary until the optical level is accurate in all directions. As long as the bubble in the circular level is central, the automatic compensators will make the necessary fine adjustments.

2.Look through the eyepiece of the optical level towards the leveling staff. Turn the focusing knob (clockwise or anticlockwise) until the details of the staff are clear.

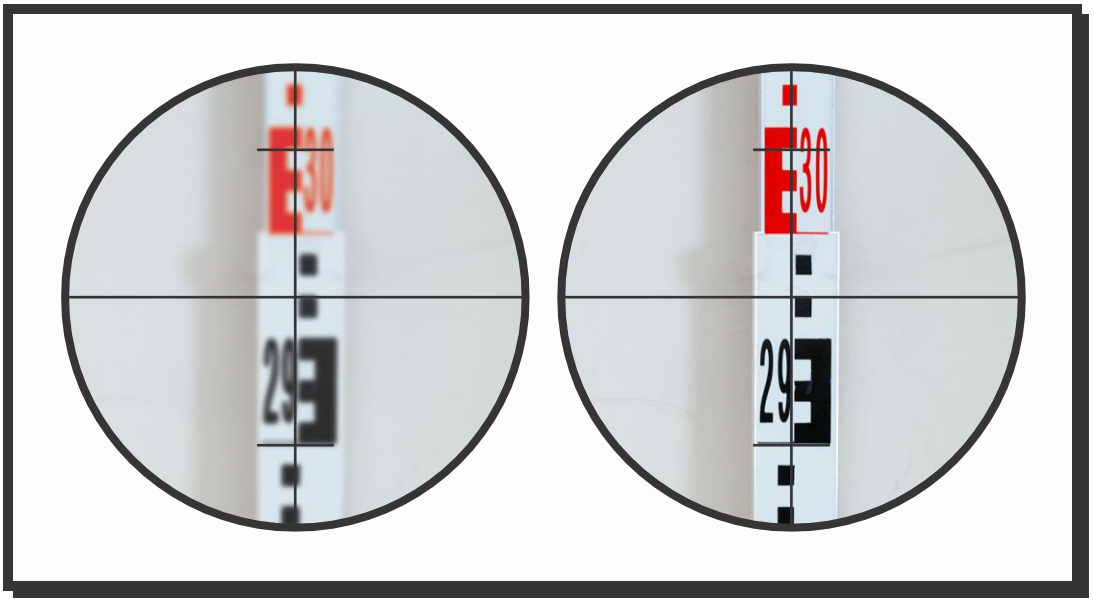
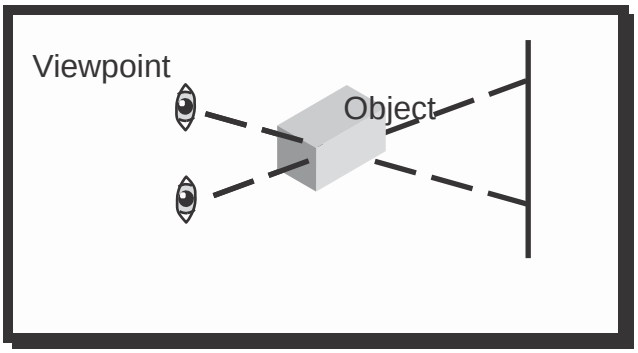


Fig.2.5 leveling staff clearing by Turn the focusing knob (clockwise or anticlockwise).

3.Adjust the eyepiece (by turning clockwise or anticlockwise) to eliminate parallax error.

Fig.2.6 Parallax error



- **parallax**

Parallax is the difference in the perceived position of an object viewed along different lines of sight; that is, as you can see above, the background behind the object will seem to be in a different position.

Hold an object in front of your face at eye level. Look at it with one eye closed then the other eye closed. What do you notice?

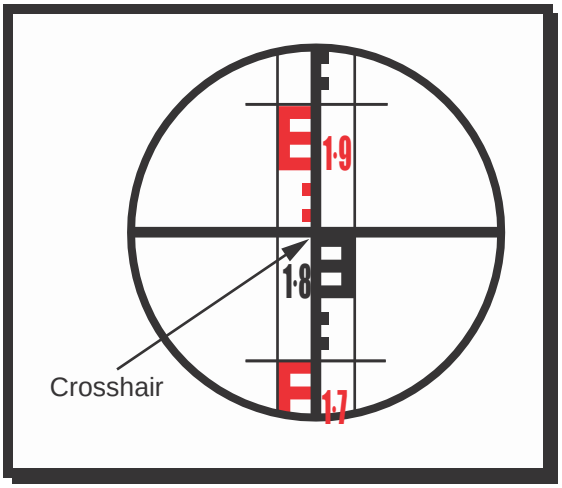
When you look through an optical levelling instrument, parallax error will distort your view of the markings on the staff.

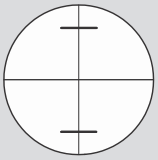
You can check for this error in an optical level by moving your eye up and down in front of the eyepiece. If the crosshairs (the marks on the telescope glass) appear to move in relation to the view in the telescope, parallax error is present

Taking a reading

When you look through an optical level, you'll see a horizontal line and a vertical line creating a crosshair. When you look at the staff, the level reading is the measurement at the exact centre of the cross, as pictured here.

Fig.2.7 takin reading





There are two short, parallel lines at the top and bottom of the view. These are called **stadia lines**. These lines are used to measure distance.

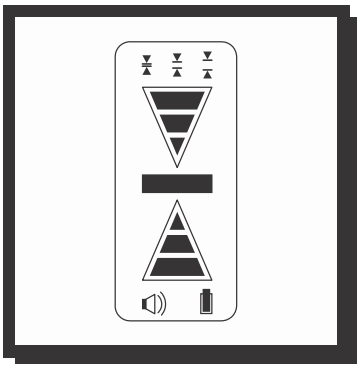
- **Using a laser level**

Laser levels vary from make to make and model to model. Before you use a laser level, read the manufacturer's instructions to familiarise yourself with that particular instrument.

The following information is a basic guide to setting up and taking level readings with a rotating laser level as these are the most commonly used on Australian building sites.

- **Setting up**

  - ✓ Securely mount the laser level on a tripod or suitable surface.
  - ✓ Press the power button on the instrument, allowing enough time (approximately 60 seconds) for the laser to self-level.
    The laser head may begin to rotate before the self-levelling is complete.
  - ✓ Select the required rotation speed.



- **Taking a reading**

1.Mount the laser receiver on the staff at the measurement position, turn it to face the laser beam then press the receiver's power button.

2.Slowly move the receiver in an upwards and downwards direction until the laser beam indicator arrows appear and you hear an audible signal.

3 .Using the indicator as a guide, move the receiver up or down until the centre line lights up and you hear a continuous sound. This shows you that the laser beam is Move receiver receiver **up** the staff

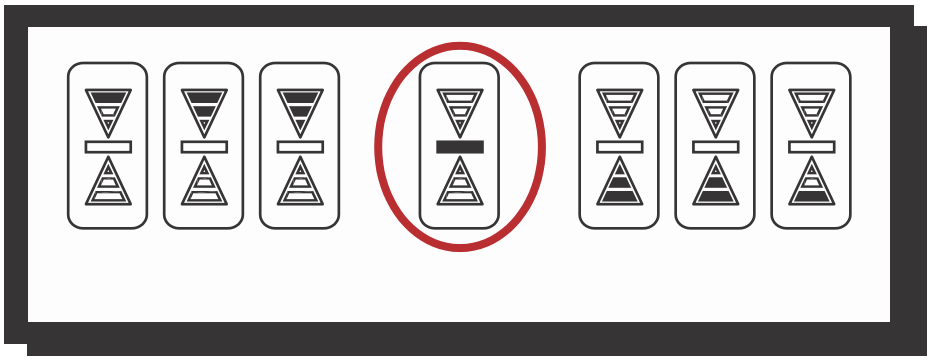


Fig.2.8 Down the staff precisely level with the receiver.

4.Lock the receiver into place on the staff and read the measurement at the indicator line.

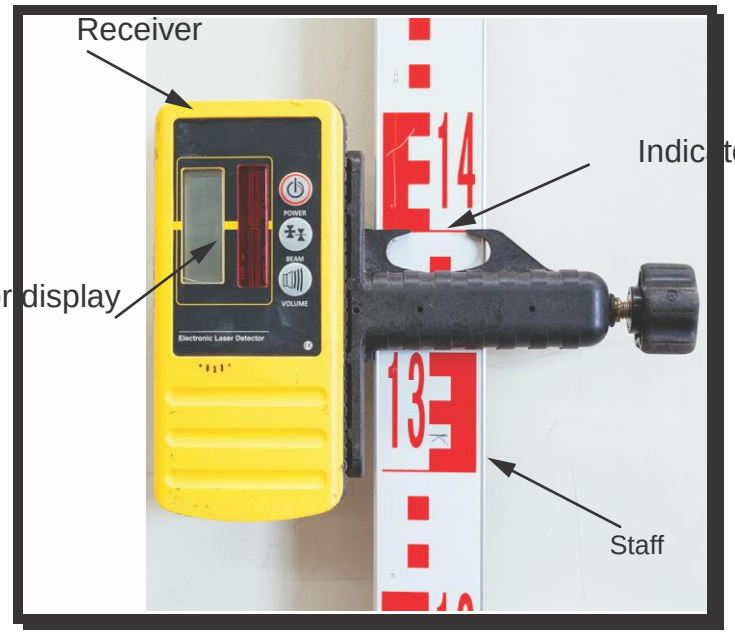


Fig.2.9 locking receiver to staff to take measerements

2.3.2. Checking the level's accuracy

Levels can move out of adjustment so that their line of sight (line of collimation) is not truly horizontal. This will cause errors in readings which become greater as the viewing distance increases. However if a back sight and a foresight are exactly equi-distant from the instrument, the error in each sighting will cancel each other out.

This feature can be used to check the accuracy of a level by the following simple method which is depicted in figure below.

- install three pegs or marks firmly in the ground at distances of 30 m apart in a straight line; the centre peg is only to mark the distance, but the outside two shall be firm enough for reliable change points
- set up the level over the centre the staff on each of the outside Book these values and calculate difference. This will be a true difference, as the distances are equal and any errors will be
- set up the level about 4 m to the far outside pegs. Read the staff on the then on the one 64 m away. Book calculate the apparent height difference

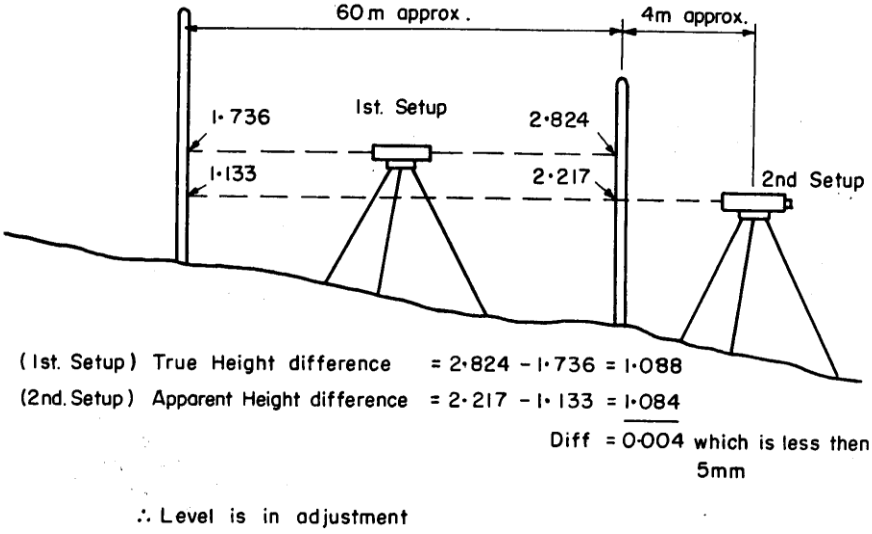


fig.2.10 A method for checking the level accuracy

- compare the two height differences; if the instrument is in adjustment

(i.e. its collimation is true) they will be within 5 mm.

If the instrument's collimation appears to be out, recheck by repeating the process.

Then, whilst setup at one of the outside locations, adjust the instrument (according to the manufacturer's instructions) so that it reads the correct value on the far staff, checking it against the near one. Two staves are useful for this.

This type of level check shall be carried out at least once per year, preferably just prior to carrying out a round of station inspections.

The details and results of the checks shall be recorded in a numbered level book and be readily retrievable as a quality record, and the date of this calibration check shall also be recorded in the instrument inventory.

Example-2

Setting up Leveling devices

• Start by placing the tripod over the point with the legs spread and extended about halfway.

• You want to have the plate as level as possible.

Figure2.11. Placing tripod

• Mount the instrument in the center of the plate with the shape of the instrument bottom plate and the trip aligned

• Coarsely level the instrument by adjusting the leg length of the tripod. When looking at the level bubble, that side indicates the high side

Figure2.12. Adjusting the instrument

• Adjust the instrument by adjusting the leveling screws.
• The bubble is approximately centered by using the thumb and first finger of each hand to simultaneously screws.
• Rotate the telescope by 900 and adjust the remaining leveling screw until it is precisely c

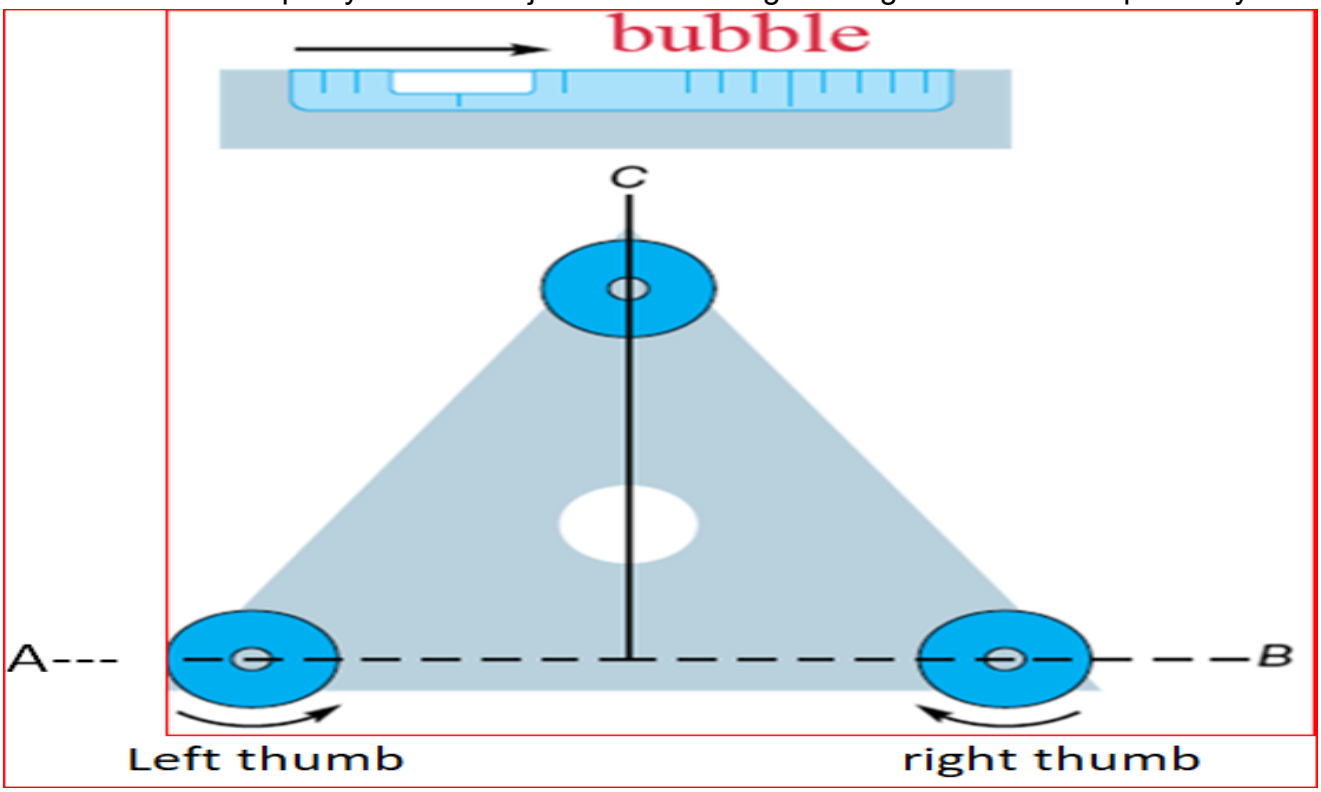


Figure 2.13.the sign of fully adjusted equipment

A bubble follows the left thumb when turning the screws

2.4 Levelling device tolerance checks

As most levels will have some level of collimation error, a method is required to check. if the error is within acceptable limits. This is known as a **two-peg test**. This needs to be conducted when using a new or different level for the first time and at regular intervals thereafter.

Two peg test

Stage 1

On fairly level ground, two points A and B are marked a distance of Lm apart. In soft ground, two pegs are used, on hard surfaces nails or paint may be used.

The level is set up midway between the points at C and carefully levelled.

A levelling staff is placed at A and B and staff readings S1 (at B) and S2 (at A) are taken.

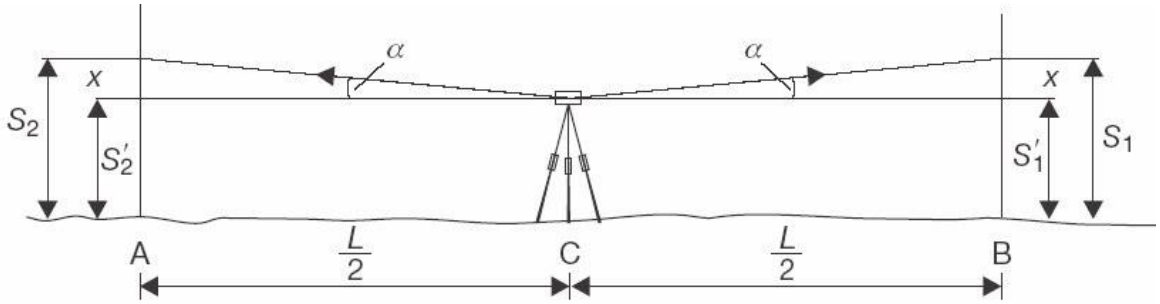


Fig.1.14 1st stage of checking tolerance

The two readings are:

$S1 = (S_1' + x)$ and $S2 = (S_2' + x)$

S_1' and S_2' are the staff readings that would have been obtained if the line of collimation was horizontal, x is the error in each reading due to the collimation error, the effect of which is to tilt the line of sight by angle α. Since AC = CB, the error x in the readings S_1 and S_2 will be the same. The difference between readings S_1 and S_2 gives:

$S_1 - S_2 = (S_1' + x) - (S_2' + x) = S_1' - S_2'$

This gives the true difference in height between A and B. This demonstrates that if a collimation error is present in a level, the effect of this cancels out when height differences are computed provided readings are taken over equal sighting distances.

Stage 2

The level is then moved so that it is L/10m from point B at D and readings S_3 and S_4 are taken.

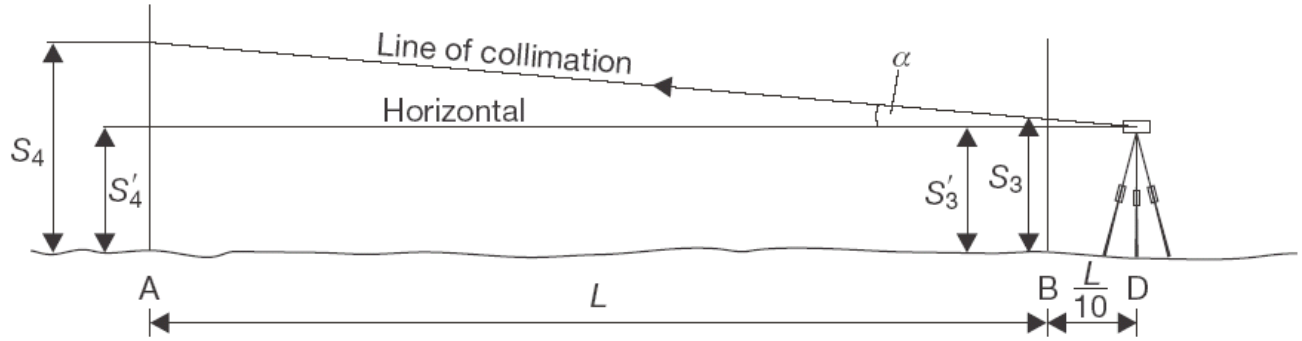


Fig.1.15 2nd stage of checking tolerance

The difference between readings S_3 and S_4 gives the apparent difference in height between A and B. If the level is in perfect adjustment then: $S_1 - S_2 = S_3 - S_4$

However this is not always the case and that an error term (e) needs to be estimates

e = (S1 – S2) – (S3 – S4) per Lm

If the results of these tests show that the collimation error is less than 1mm per 20m (or Some specified value). If the collimation error is greater than this specified value then the level has to be adjusted. This is normally done by the manufacturer or a trained technician.

Example

Readings obtained from a two peg test carried out on an automatic level with a staff placed on two pegs A and B 50m apart are:

Staff reading at A = 1.283m Staff reading at B = 0.860m

With the level position 5m from peg B (L/10):

Staff reading at A = 1.612m Staff reading at B = 1.219m

Calculate the collimation error of the level per 50m of sighting distance

Solution

S_1 = 0.860M S_2 = 1.283M S_3 = 1.219M S_4 = 1.612M

e = (0.860 – 1.283) – (1.219 – 1.612) per 50M

= (-0.423 – (-0.393)) = -0.030M per 50M

Self-Check -2	Written Test

Directions I: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the concepts of leveling devices (3 points?)
2. What is leveling setting up?(3 points)
3. Write the safety of leveling? (4 points)
4. write the methods of two-peg checking? (4 points)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Name: _____ Date: _____

Score = _____

Rating: _____

Short Answer Questions

1_____
2_____
3_____
4_____

Directions II: Answer all the questions listed below.

Choose item: chose the correct alternative and write letter of the correct answer on the provided answer sheet (6 points)

2. _____is used to project a line of sight that is at a 90 degree

A. Electronic level C. Optical level

B. Automatic level D. Laser level

3. A staff carried by the operator is equipped with _____

A. Sprit level B. Plumb bob

C.Movable sensor D. No answer

A. Laser level

B. Rod level

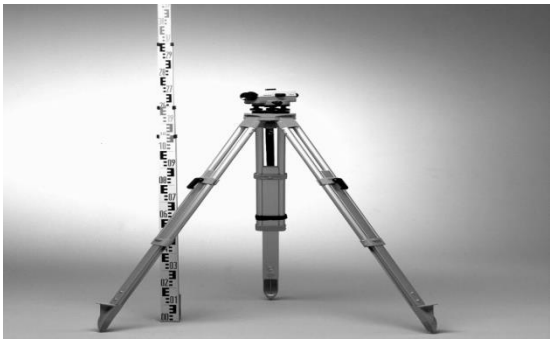
C. Electronic level

D. Opticallevel

3. _____ is used to make sure that the rod is held vertical when making a reading

Information sheet-3	Applying leveling staffs

3.1 concepts of leveling staffs



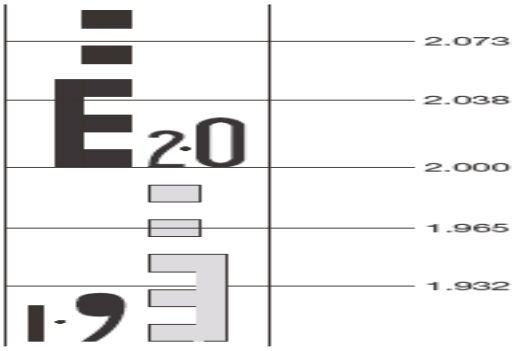
To take a precise level reading, you use a staff to measure elevation in metres to three decimal places, eg 1.255; that is, the metres and tenths, and hundredths and thousandths of a metre. While there is a variety of staffs available, the E-staff is the most commonly used on construction sites.

3.2 Leveling staff and accessories

Leveling rods are manufactured of metal, wood, or fiberglass. They are graduated in feet or meters and can be read directly to the nearest tenth of a foot or centimeter. For less precise work, an extendable or folding rod may be used. The sole of the rods are made of a metal base, machined for accuracy. Precise rods have a built-in circular bubble level to maintain the plumb of the rod. Placing the rod on a stable, consistent surface and maintaining plumb are keys to completing accurate, differential-leveling measurements.

- **Reading an E-staff**

An E-staff has a series of ‘E’ shapes printed at set intervals along its length, with two small squares between each. These shapes are used like the lines on a ruler or tape measure but are easier to see at a distance.



Many types of staff are used with varying lengths and different markings.

The E-type face is commonly used in the UK,Ireland and over the worlds. This can be read directly to 0.01m and by estimation to the nearest mm.

The staff must be held vertically – a circular bubble is sometimes fitted to help this.

Note: The design and colour of the staff can vary; however, most staffs use a combination of black and red with an alternating pattern of E-shapes

The staff is initially divided into **metres** and **tenths of metres** (100 mm).

These are labelled with a number with a decimal point.

The measurement line always lines up with either

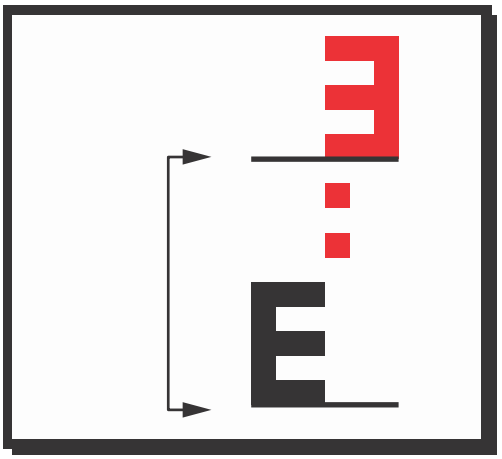
the bottom or top of each E-shape.

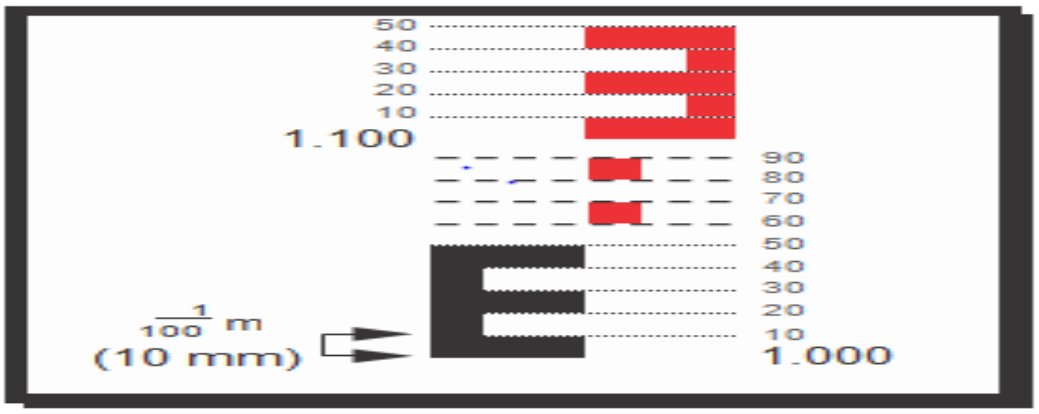
Each vertical block of colour (and space between)

in the shapes is **one hundredth of a metre** (10 mm) high.

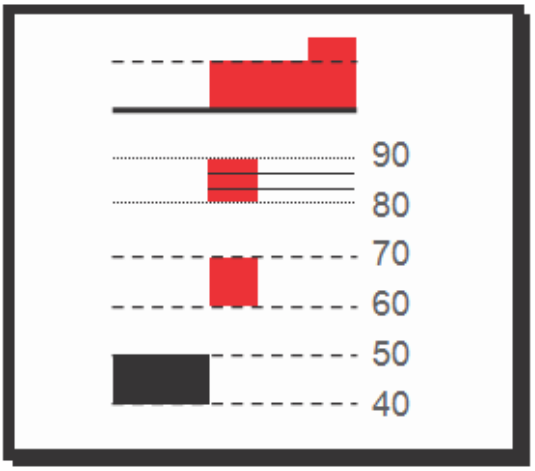
There are 10 separate blocks of colour (and space) between each numerical label (10 × 10 mm = 100 mm).

Note: You will notice that each E-shape is 50 mm (5 × 10 mm).





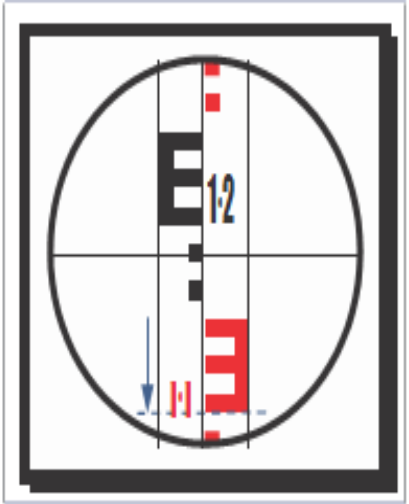
As each block is 10 mm high, the **thousandths of metres** (1 mm) can be estimated by dividing each colour block (or space) into 10.



The process for taking a level reading on an E-staff is completed in three steps.

The process for taking a level reading on an E-staff is completed in three steps.

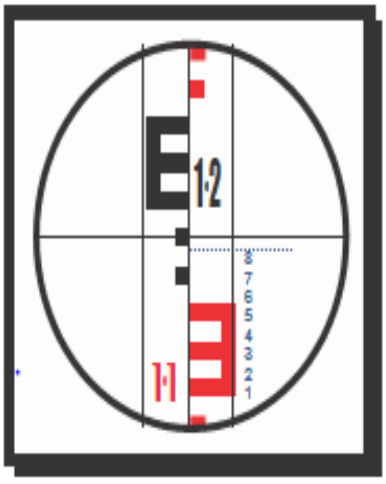
Step 1



Read the **metres/tenths of metres** by noting the number below the crosshair.

Reading: 1.1

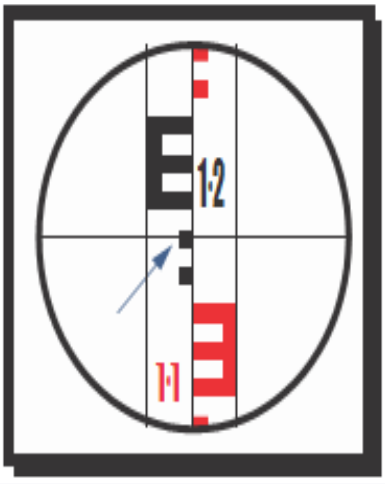
Step 2



Read the **hundreths of metres** by counting the blocks of colour and the space between the number and the crosshair.

Reading: 1.18

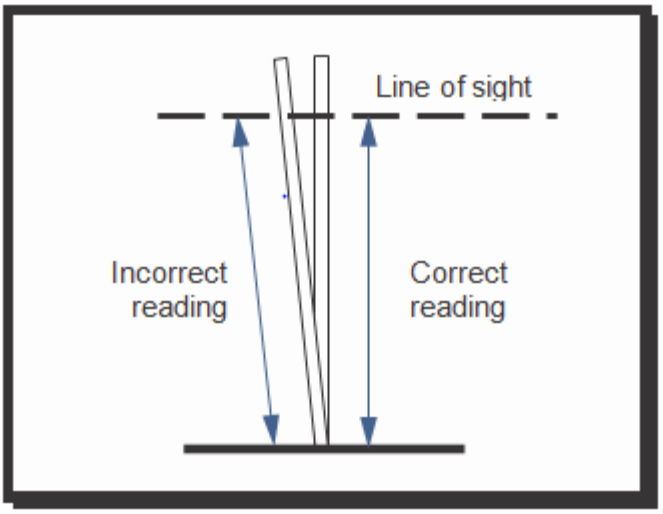
Step 3



Read the **thousandths of metres** by estimating the number of millimetres in the colour block (or space) below the crosshair.

Final reading: 1.187

3.3. Holding a staff



Taking a level with an optical leveling instrument requires an operator to look through the and take the reading, and an assistant to hold the measurement point.

A land surveyor's assistant is also known as a because surveyor's measure distances with a chain rather than a tape.

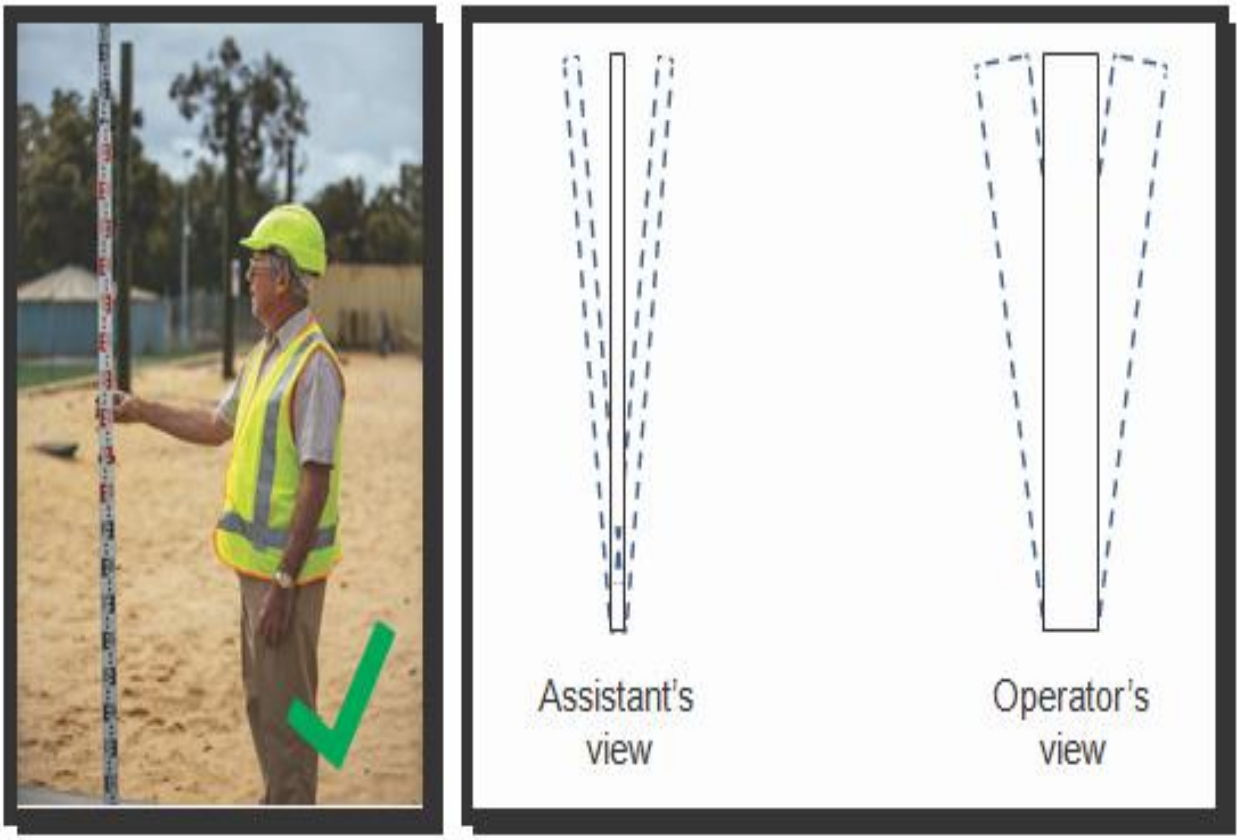
The most important aspect of holding a staff is it's plumb (vertical). If it's leaning in any crosshairs will appear to be further up the staff reading will be incorrect.

If the assistant stands behind the staff, neither the the instrument operator can tell whether the staff is the side.

Note: The movements of the staff in this direction are generally referred to as 'fore and aft'.

If the assistant stands to the side of the staff, they can tell if it's vertical 'fore and aft',

while the instrument operator can see if it's vertical the other way.



- **Staff level**

You can buy a small circular level that's made especially for keeping the staff vertical. It's held against the staff and the assistant holds the staf

- ## Communication

Good communication is essential in all construction tasks because, in most situations, you'll be working with a partner or a team.

The challenge of communicating while completing a levelling task is that you will usually be working some distance from your partner on a noisy worksite. Levelling instrument operators and their assistants traditionally use hand signals to pass messages to each other.

While some hand signals are simple and common to most worksites, there is no standard set used across the construction industry in Australia. So you must always make sure that you and your partner or team agree on the signals to be used when you're carrying out levelling tasks.

Self check 3	Communication

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Look at the signals used in these photographs. What do you think they mean?

2.

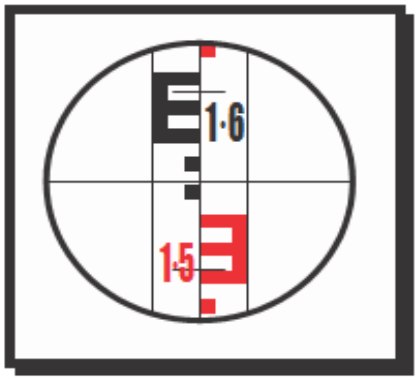
self Taking level readings

Your lecturer will identify positions in your classroom or workshop for you to take level measurement readings. Record each reading in this table.

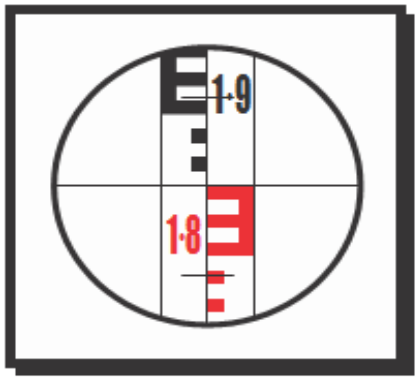
Location name/number	Staff reading

3. Level readings

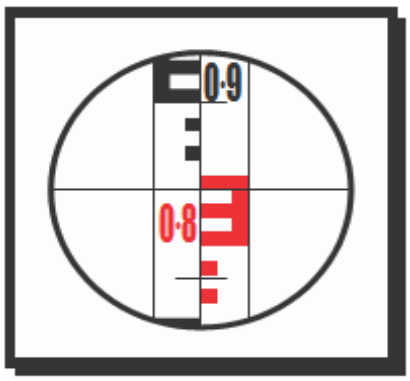
Read the metres and tenths, and hundredths and thousandths of metres on these staff sights. Write the level measurement reading below each image.



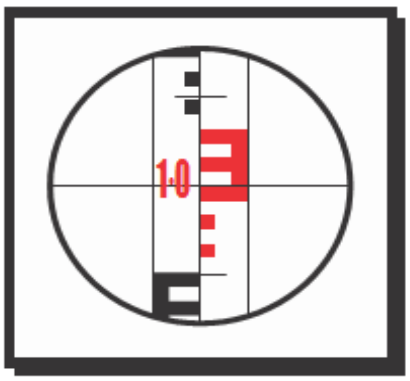
Reading: _____



Reading: _____



Reading: _____



Reading: _____

Note: **Satisfactory rating – above 6 points** **Unsatisfactory - below 6 points**

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

1_____
2. _____
3._____

Information sheet-4	Shooting level and transferring heights

4.1 Concepts of Shooting level and transferring heights

Shooting mark is the process of testing the elevation of a construction project in order to level or slope it. Shooting mark properly is critical to every surface of construction including excavation, pipe laying and forming footers and foundations. The importance of shooting grade and leveling or sloping the ground in accordance to the plans can not be overstated.

It affects a project from the ground up. As important as it is, shooting grade is simple.

4.2. Importance of shooting

A survey elevation shot, an important tool in both engineering and construction, determines the elevation of an unknown point by referencing a known point, called a benchmark, or BM.

A survey elevation shot achieves this by measuring vertical distances between different points by reading a leveling rod through the cross-hairs of an engineer's level. Surveyors use this process in topographic surveys and road, house and sewer construction. This task requires a partner to hold the leveling rod.

4.3. Necessary steps

Step 1

Find a point of known elevation -- a benchmark, or BM -- to which you will reference your survey elevation shots. You can use any object or point as a reference provided you know its exact elevation.

Step 2

Label five columns in your field book with the headings Back-Sight (BS), Height of Instrument (HI), Fore-Sight (FS), Elevation (ELEV) and Description (DESC).

Step 3

Fasten the engineer's level to the tripod with the fastening screw and level it using the fine leveling screws. Set the level up in a location where you can see both the BM and the area in which you wish to determine an elevation.

Step 4

Instruct your partner to hold the leveling rod vertically on the BM. Sight the rod with the engineer's level and record the reading in the field book. This is your BS. To determine the HI, add this reading to the BM elevation and record this number in the field book in the ELEV column.

Step 5

Instruct your partner to move the leveling rod to the other points where you wish to determine elevations. Record the readings of the leveling rod under FS in the field book. Include a description in the column labeled DESC for each point that will allow you to recall which FS corresponds with each location.

Step 6

Subtract the recorded FS from the recorded HI. Record the values in the ELEV column of your field book. You now have elevations of each point on which you have taken a shot.

4.4. Examples shooting for buildings

Step 1

Set up the tripod of the laser level or transit; spread the three legs, each an equal distance from the other two. Put the laser level or transit on top of the tripod. Level the base of the tripod using the three bubble levels as indicators. Adjust the knobs on the base, in conjunction with one another, until all three bubbles are within the marks indicating level.

Step 2

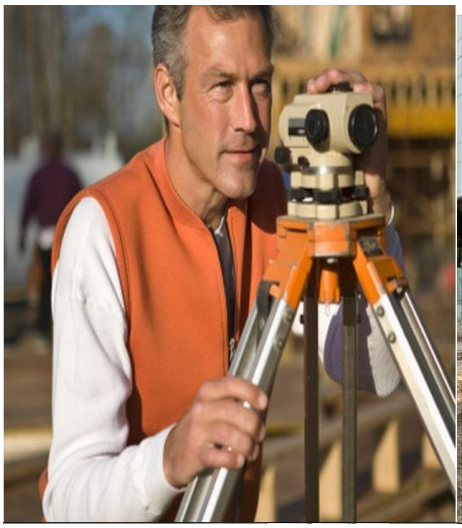
Position you partner within the building site or in the pipe trench. Direct her to raise or lower the receiver on the grade rod. When the receiver is at elevation with the laser level's eye, it delivers a constant beep. If the receiver is too high or low on the grade rod, the beep is broken with intervals of silence. For a transit, simply read the elevation on the rod through the transit and record the value.

Step 3

Set the grade rod at different locations on the site. Record whether the ground, concrete forms or trench are above or below the original reading. Inconsistencies in grade require further excavation. Consistency is typically within 1/24 of a foot, or half an inch. Trenches for gravity fed lines have a constant fall, at least 1/8 inch per foot. Use the grade rod to test the fall.

The following steps are taken when using a level to measure heights from shooting;

1. Set up the tripod
2. Ensure the top is level
3. Push legs firmly into the ground
4. Attach level
5. Use foot screws to centralise the circular bubble
6. Test to see if the compensator is working
7. Remove parallax
8. Read from marks BS and FS



To understand more,please Click Here For my how to level ground with a laser level guide

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1.what are the necessarly steps for shooting leveling?

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

Score = _____

Rating: _____

1_____

Information sheet-5	Documenting results of leveling procedure

5.1 Documenting results of leveling procedure

Results of leveling procedure Documenting are the record of work done in the field.
They contain the complete graphic, written (or combination thereof) survey records which depict each step of the activities. Results of leveling procedure notes should be recorded on suitable forms, special notebooks or in digital format. They should enable knowledgeable persons to interpret and use the survey and its results, and to retrace the footsteps of the surveyor. Field notes are not an accessory to the survey; they are an integral part of the survey. A survey is never completed until field notes are submitted, checked, and filed.

5.2 Forms of Field Notes

STA	BS	HI	FS	ELEV

Sum BS – Sum FS = Difference of Elevation

5.3 Responsibility of recorder

The recorder is responsible for all documentation during the survey; completes all note forms properly; ensures that all requirements are satisfied; ensures that calculations and checks are performed without errors and expeditiously and that all technical specifications have been satisfied; and prepares the description of BMs and any supplemental vertical-control points.

5.4 Importants of Field notes

Field notes perpetuate a survey even when dangers have rotted and monuments are eliminated. Good field notes make it possible to re-establish lost monuments or other measured data. Conversely, incomplete, illegible or incorrect field notes cause the time and money invested in the survey to have been wasted.

Field notes of boundary or right-of-way surveys, together with diaries and survey crew reports, are important documentation in court cases arising between the department and landowners or contractors.

Field notes are the means of communication between field and office personnel. The office personnel should be able to understand and process the data without needing additional explanations.

In view of the importance of the field notes, the duties of note keeping should always be assigned to a knowledgeable member of the crew. The notekeeper should have a thorough understanding of the purpose of the survey and the operations

5.5 Methods of Levelling Field books

There are two methods of booking and reducing the elevation of points from the observed staff readings.

1. Rise & Fall method
2. Height of collimation method.

5.5.1 Rise and Fall Method

Each reading is entered on a different line in the applicable column, except at change points where a fore-sight and a back-sight occupy the same line. This is to connect the line of sight of one setup of the instrument with the line of sight of the second setup of the instrument. From the above figure it can be seen that they are not at the same level. R.L. of change point *D* is obtained from the first line of sight by comparing intermediate sight 1.645 with foresight 1.515, i.e. a rise of 0.130m. For the R.L. of next point *E*, back sight 1.815 is compared with intermediate sight 1.715, i.e. a rise of 0.100m.

At the end of the table arithmetic checks are shown. If a positive result is obtained there is a <u>rise</u> on the ground b/n the points, similarly of a negative result id obtained a <u>fall</u> on the ground can be conclude.

The checks are:

∑ Backsights - ∑ Foresights = ∑ (Rises) - ∑ (Falls) = Last R.L. – First R.L.

<u>Cheking levels (Arithmetic check)-</u> The difference b/n the sum of the B.S & sum of rise & the sum of fall & should also be equal to the difference b/n the R.L of Last & first point. Thus

∑B.S - ∑ F.S = ∑ Rise- ∑Fall = Last R.L – First R.L

It is advisable that on each page, the rise & fall calculations shall be completed & checked by comparing with the difference of the back & fore sight column summations, before the R.L calculations are commenced.

Start	B.S	I.S	F.S	Rise	Fall	R.L	Remark
BMA	2.462					165.265	B.M
1	2.660		2.048	0.414		165.679	T.P
2		2.381		0.279		165.958	
3		2.042		0.339		166.297	
4		1.984		0.058		166.355	
5	2.990		2.656		0.672	169.683	T.P
6		3.220			0.230	165.453	
7		3.123		0.097		165.550	
8			2.885	0.238		165.788	
∑ 8.112		7.589		1.425	0.902		

∑ B.S- ∑F.s = ∑Fall =∑Rise= Last R.L – First R.L

8.112 – 7.589 = 1.425- 0.902= 165.788-165.265

0.523= 0.523 0.523

The Reduced level of the points is calculated by adding the rise to the previous reduced level or by subtracting the Fall to the previous Reduced level of a point.

5.5.2 Height of Collimation Method

In this methods, the height of collimation i.e, the distance from datum to the line of sight, is calculated for each setting of the instrument by adding back sight to the elevation of the B.M. The reduced level of the turning point is then calculated by subtracting from H.C of the Foresight. For the next setting of the instrument, the H.C is obtained by adding the B.S. taken on T.P to its R.L (reduced level). The process continues until the R.L of the last point (Fore sight) is obtained by subtracting the staff reading from height of collimation of the last setting of the instrument. Arithmetic level (checking of Level) – The difference b/n the sum of B.S & the sum of F.S should be equal to the difference b/n the last R.L & the first R.L.

∑ B.S. - ∑ F.S. = Last R.L. – First R.L.

Examples- The following staff readings were observed successively with a level, the instrument having been moved after third, sixth and eighth readings:

2.228; 1.606; 0.988;2.090;2.864;1.262;0.602; 1.982;1.044;2.684 meters.

Soln- Since the instrument was shifted after third, sixth & eigth readings, these readings will be entered in the F.S column & there fore, the Forth, seventh and ninth readings will be entered in the B.S column & the last reading in the F.S. Column. All other readings will be entered in the I.S. column.

Stan	B.S	I.S	F.S	H.C	R.L	Remark
1	2.228			1010.693	1008.465	B.M
2		1.606		1010.693	1009.087	
3	2.090		0.988	1011.795	1009.705	T.P
4		2.864		1011.135	1018.931	
5	0.602		1.262	1011.135	1010.533	TP
6	1.044		1.982	1010.197	1009.153	TP
7			2.684		1007.513	
Check	5.964		6.916			

∑ B.s- ∑ F.s = Last R.L – First R.L. 5. 964-6.916 = 1007.513 – 1008.465

- 0.952 = - 0.952

Stand	B.S	I.S	F.S	Rise	Fall	R.L	Remark
1	2.228					1008.465	B.M
2		1.606		0.622		1009.087	
3	2.090		0.988	0.618		1009.705	T.P
4		2.864			0.774	1008.931	
5	0.602		1.262	1.602		1010.533	TP

6	1.044		1.982		1.380	1009.153	TP
7			2.684		1.640	1007.513	
∑	5.964		6.916	2.842	3.794		

∑ B.S- ∑ F.S = ∑ Rise - ∑ Fall = Last R.L – First R.L

s.964-6.916 = 2.842-3.794 = 1007.513-1008.465

- 0.952 = - 0.952 = -0.952

Self check 5	**Written test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. what are documenting information?
2. what are methods note booking?

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

Answer Sheet

Name: _____ Date: _____

Short Answer Questions

Score = _____

Rating: _____

1_____

Operation sheet -1	Identifying heights or levels to be transferred/established

Topic: techniques of Identifying heights or levels

Procedures:

Step 1. Wear PPE.

Step 2. Read and understand the given drawing

Step 3. Select working site

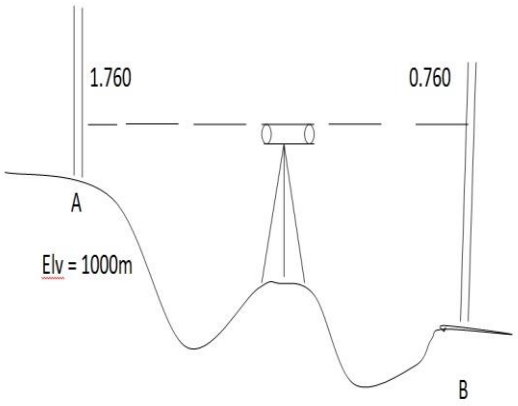
Step 4. Select materials,tools and instruments

Step 5. Use appropriate methods of leveling

Step 6. Set up instruments

Step 7. Eliminate parallax

Step 8. Document your results



By using the above procedure and diagrams do the LAP test below?

Operation Sheet -2	setting-up and testing leveling devices

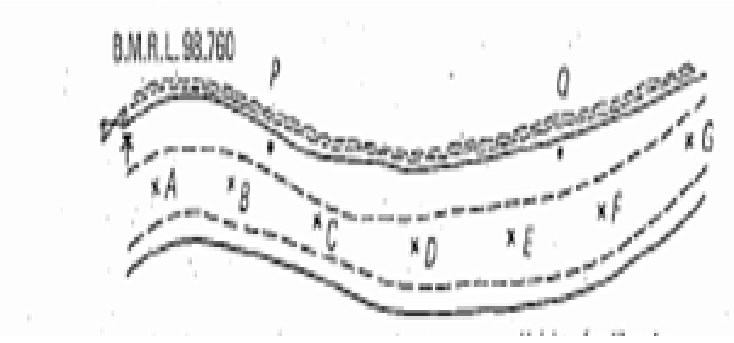
Topic : **setting-up and testing leveling devices**

1. Identify the device's to be setted up
2. Set up the device
3. Ensure the top is level
4. Push legs firmly
5. Use foot screws to centralise the circular bubble into the ground
6. Attach level
7. Turn the receiver on and test for visual and audible signals.
8. Move the receiver up and down in front of the laser to check the level indicator
9. Test by using Two peg test to see if the compensator is working
10. Remove parallax

Operation Sheet -3	Applying leveling staffs

Topic: Techniques of Applying leveling staffs

1. The level is set up at P where BM may be observed and readings taken at points A, B, and D



2. Remain staff at point D.
3. Move the level to Q, set up and level
4. Repeat this procedure until all the required levels have been obtained
5. position the final staff at a point of known RL

Operation Sheet -4	Shooting levels and transfering heights

Topic : Shooting levels and transfering heights

Step1. Set up the tripod

Step 2. Ensure the top is level

Step 3. Push legs firmly into the ground

Step 4. Attach level

Step 5. Use foot screws to centralise the circular bubble

Step 6. Test to see if the compensator is working

Step 7. Remove parallax

Step 8. Read from marks BS and FS

Operation Sheet -5	Documenting results of leveling procedure

Topic:- Documenting results of leveling procedure

1. Follow proper note keeping procedures
2. Start at a BM with an elevation of 100 feet.
3. Make up only the Back sight and Foresight rod readings, place them in the correct locations on your note sheet, and perform accurate calculations.
4. You must take a total of 15 readings, INCLUDING moving the tripod 4 times.
5. Your LAST reading will be back at the BM (with an original elevation of 100.00 feet). Adjust your rod readings to end up with a final BM rod reading of 100.05.
6. take survey notes and make accurate calculations.

LAP Test -1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within a given hours.

Task 1	Identifying heights or levels to be transferred/ established
Task 2.	Setting up and testing levelling devices
Task 3.	Applying levelling staffs accurately
Task 4	Shooting levels and transferring heights to required location
Task 5	Documenting results of the levelling procedure

References

- CPCCCA3023A Carry out leveling operations Toyota 2L-T, 3L engine repair manual.
- http://www.engr.mun.ca/~sitotaw/Site/Fall2007_files/Lab2_Lecture2_leveling.pdf
- https://www.diydoctor.org.uk/projects/Usingachalkline.htm
- Leveling set up process1,leveling vedio,
- Staff reading 2.

Masonry

Level-II

Learning Guide-43

Unit of Competence:Apply basic leveling procedures

Module Title: Applying basic leveling procedures

LG Code: EIS MAS2 M09 LO3-LG-43

TTLM Code: EIS MAS2 M09 TTLM 1019v1

LO 3: clean up

Instruction Sheet	Learning Guide # 41

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

Cleaning Work area

Reusing, recycling and disposing waste materials

Maintaining of plant, tools and equipment.

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to –

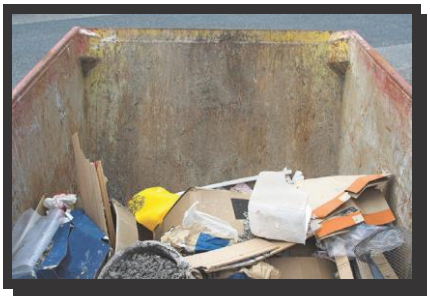
- Relevant legislation, regulations and job specifications
- Clean, Plant, tools and equipment as standard work practices
- Check, Plant, tools and equipment as standard work practices
- Maintain Plant, tools and equipment as standard work practices and
- Store Plant, tools and equipment as standard work practices

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5” **in page-**95,97,100 and 104 respectively .
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” **in page -96, 99, 103 and 106** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “module 10**.**

Information Sheet-1	Clean work area

1.1 Clean work area



When you complete any task on a building site, you must clear your work area to ensure the safety and convenience of your workmates, other construction teams and the public. This process includes:

- recycling or disposing of any waste material
- cleaning, maintaining and storing equipment
- safely filing or storing plans, documents and records
- cleaning up the area.

1.2. Relevant legislation, regulations and job specifications

State and territory Regulations usually require a site to be kept and left in a clean, safe condition. The tasks involved in setting out by level don't produce a lot of clutter or rubbish but all construction workers must know and follow the site policies and procedures for maintaining a tidy, organised and safe workplace including:

- clearing potential safety hazards
- safe waste disposal
- recycling of materials
- maintenance and storage of tools and equipment.

- Inspection shall be carried out daily to ensure that sufficient workmen/women, tools and facilities are provided to maintain the standard of hygiene.

- Final cleaning of the site and removal of all temporary facilities shall be carried out to approval at completion of works.

Self-Check 1	Written Test

Instructions: Answer the questions listed below. Write your answers in the sheet provided in the next page.

1. Why do you apply clean up rules to work area? (5 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date: _____**

Short Answer Questions

1. _____

_____

Information Sheet-2	Dispose, Reuse and Recycle waste materials

2.1 Definition

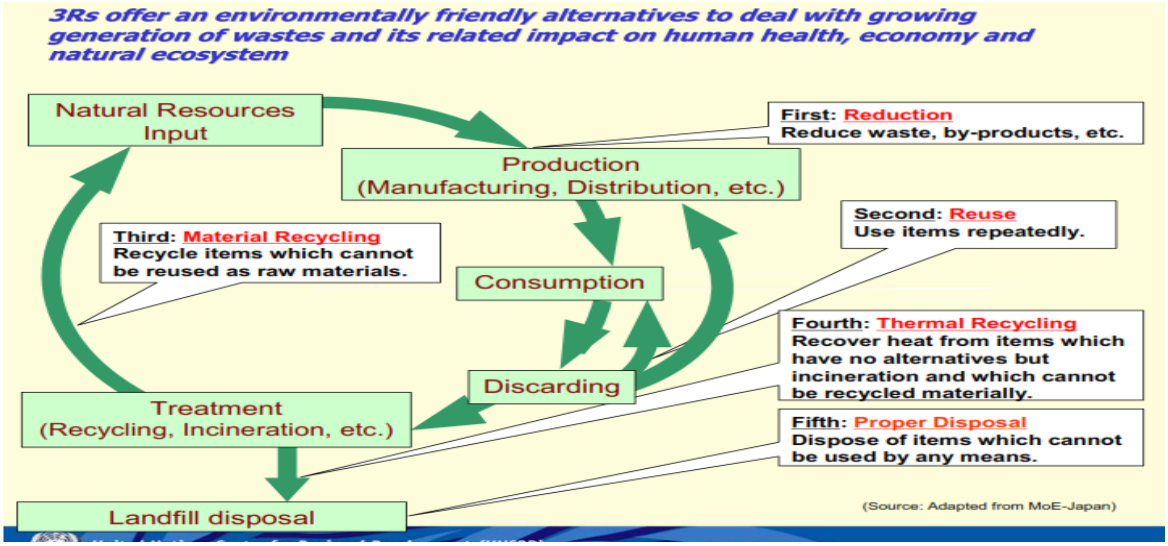
Disposing Removing and destroying or storing damaged, used or other unwanted domestic, agricultural or industrial products and substances

Recycling means turning an item into raw materials which can be used again, usually for a completely new product. This is an energy consuming procedure.

Reusing refers to using an object as it is without treatment. This reduces pollution and waste, thus making it a more sustainable process.

2.2 Purpose

When looking into **environmental sustainability**



2.2. **Advantages of 3R'S**

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community and the environment.

Recycling reduces waste disposal by transforming useful materials such as plastic, glass and paper into new products

The reusing process is not just about re-purposing materials, but the object as it is. This includes buying and selling used goods and repairing items rather than discarding them. Reusing is better than recycling because it saves the energy that comes with having to dismantle and re-manufacture products. It also significantly reduces waste and pollution because it reduces the need for raw materials, saving both forests and water supplies.

2.3 **Waste management**

Construction projects create a lot of waste including general rubbish and used, damaged or surplus materials. All waste must be disposed of appropriately.

- Non-degradable substances and organic material like food and vegetation should be disposed of at a landfill site.

•Left-over materials in good condition and in useable sizes or quantities can be salvaged.

- Used materials that can be repurposed or reprocessed can be recycled.

Note: Hazardous waste such as asbestos must be handled by removal specialists.




There are laws which outline how waste materials should be dealt with and large fines can be issued if they're not followed. Companies and contractors usually develop

policies and procedures to make sure that everyone on the building site complies with these requirements.

Therefore, Waste that cannot be reused or recycled in some form eventually finds its way to **disposal**. This disposal includes landfills, but an increasing number of municipalities have elected to divert waste into resource recovery. These recovery methods use the waste to generate electricity or produce rawmaterials for industry.

Self-Check -2	Written Test

Instructions*:* Answer all the questions listed below. Write your answers in the sheet provided in the next page.

1. What are the advantages of applyinng 3R's for enviromental sustainability? (5 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

Short Answer Questions

1. _____

_____

Information Sheet-3	Maintaince Of Plant, Tools And Equipment.

Maintenance of tools and equipment

Tools must be checked, maintained or, if necessary, repaired when a job is completed to ensure they:

- Remain In A Good Working Condition
- Are Safe To Use
- Are Ready For The Next Project.

Regular maintenance helps to preserve the quality of the tools, keep them safe and extend their life. Doing a little maintenance each time you complete a job or project can prevent costly and time-consuming repairs or replacement.

You should complete the following procedures as routine maintenance at the end of every task;

1. Wipe all tools to clear away dust or debris, and remove substances like grease or sap.
2. Pay particular attention to tools that have been used in wet or damp conditions.
3. They should be cleaned with an oily rag to prevent rust and, if rust exists, it should
4. be removed with steel wool or a wire brush.
5. Sharpen blades and replace damaged or worn components.
6. Lubricate moving or adjustable parts of tools to allow smooth, continuous operation. Lubrication reduces friction between moving parts, helps them to last longer and makes the machine more energy efficient.
7. Store tools and equipment properly so that they’re protected against

weather and theft, easy to find when needed and not a hazard to yourself, other workers or members of the public.

3.1 Clearing The Site

Keeping the site tidy is an essential part of maintaining a safe workplace. Tools, equipment and materials are all potential hazards to site workers and the public and should always be properly organised and stored when they're not being used. The pegs, pickets, stringlines and profiles you place during a leveling task can be safety hazards and should be removed once there's been sufficient progress on the construction, and the position, size and shape of the building are well established.

3.5 Dos and don'ts of plant and equipment maintenance

Do…

- Ensure maintenance is carried out by a competent person (someone who has the necessary skills, knowledge and experience to carry out the work safely)
- Maintain plant and equipment regularly – use the manufacturer's maintenance instructions as a guide, particularly if there are safety-critical features
- Have a procedure that allows workers to report damaged or faulty equipment
- Provide the proper tools for the maintenance person
- Schedule maintenance to minimise the risk to other workers and the maintenance person wherever possible
- make sure maintenance is done safely, that machines and moving parts are isolated or locked and that flammable/explosive/toxic materials are dealt with properly

Don't…

- Ignore maintenance
- Ignore reports of damaged or unsafe equipment
- Use faulty or damaged equipment

3.6 Dos and don’ts of machinery safety for workers

Do…

- Check the machine is well maintained and fit to be used, ie appropriate for the job and working properly and that all the safety measures are in place – guards, isolators, locking mechanisms, emergency off switches etc
- Use the machine properly and in accordance with the manufacturer’s instructions
- Make sure you are wearing the appropriate protective clothing and equipment required for that machine, such as safety glasses, hearing protection and safety shoes

Don’t…

- Use a machine or appliance that has a danger sign or tag attached to it. Danger signs should only be removed by an authorised person who is satisfied that the machine or process is now safe
- Wear dangling chains, loose clothing, rings or have loose, long hair that could get caught up in moving parts
- Distract people who are using machines
- Remove any safeguards, even if their presence seems to make the job more difficult

Self-Check -3	Written Test

Instructions: **Answer all the questions listed belowWrite your answers in the sheet provided in the next page.**

1. Discuss dos and don'ts of tools,equipments and machineries? (10points)

Note: **Satisfactory rating - 10points** **Unsatisfactory - below 10**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date: _____**

Short Answer Questions

1._____

_____

Information Sheet-4	Performing good housekeeping

4.1 Basic concepts

Effective housekeeping can eliminate some workplace hazards and help get a job done safely and properly. Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries. If the sight of paper, debris, clutter and spills is accepted as normal, then other more serious health and safety hazards may be taken for granted.

Housekeeping is not just cleanliness. It includes keeping work areas neat and orderly; maintaining halls and floors free of slip and trip hazards; and removing of waste materials (e.g., paper, cardboard) and other fire hazards from work areas. It also requires paying attention to important details such as the layout of the whole workplace, aisle marking, the adequacy of storage facilities, and maintenance. Good housekeeping is also a basic part of accident and fire prevention.

Effective housekeeping is an ongoing operation: it is not a hit-and-miss cleanup done occasionally. Periodic "panic" cleanups are costly and ineffective in reducing accidents.

4.2 PURPOSE

Poor housekeeping can be a cause of accidents, such as:

- tripping over loose objects on floors, stairs and platforms
- being hit by falling objects
- slipping on greasy, wet or dirty surfaces
- striking against projecting, poorly stacked items or misplaced material
- cutting, puncturing, or tearing the skin of hands or other parts of the body on projecting nails, wire or steel strapping

To avoid these hazards, a workplace must "maintain" order throughout a workday. Although this effort requires a great deal of management and planning, the benefits are many.

4.3 BENEFIT

Effective housekeeping results in:

- Reduced handling to ease the flow of materials
- Fewer tripping and slipping accidents in clutter-free and spill-free work areas
- Decreased fire hazards
- Lower worker exposures to hazardous substances (e.g. Dusts, vapours)
- Better control of tools and materials, including inventory and supplies
- More efficient equipment cleanup and maintenance
- Better hygienic conditions leading to improved health
- More effective use of space
- Reduced property damage by improving preventive maintenance
- Less janitorial work
- Improved morale
- Improved productivity (tools and materials will be easy to find)

Self-Check -4	Written Test

***Instructions**:* Answer all the questions listed below. Write your answers in the sheet provided in the next page.

1. What is good house keeping? (5 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5**

Answer Sheet

Score = _____

Rating: _____

Name: _____ **Date:** _____

Short Answer Questions

2. _____

_____

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