Plumping installation Level-II

Learning Guide-38

Unit of Competence: Carry-Out Basic Leveling

Module Title: Carrying- Out Basic Leveling

LG Code: EISPL2M 09 LO1-LG-38

TTLM Code: EISPLI2 M09TTLM 0919v1

LO 1: Prepare for work

Learning Instruction

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

- Determining job requirements
- Adhering to OH&S requirements associated with leveling activities, and the workplace environment
- Adhering to Quality assurance requirements
- selecting Tools and equipment & personal safety 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**:

- Determine job requirements of the job
- Adhere to OH&S requirements associated with leveling activities, and the workplace environment
- Adhere to Quality assurance requirements
- Select Tools and equipment & personal safety equipment

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 and Sheet 4”.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4
5. Do the “operation sheets
6. Do the “LAP test” (if you are ready).

Information Sheet-1	Determining job requirements

1.1 concept of Surveying

Surveying is the process of determining the relative position of natural and man- made features on or under the earth's surface, the presentation of this information either graphically in the form of plans or numerically in the form of tables, and the setting out of measurements on the earth's surface. It usually involves measurement, calculations, the production of plans, and the determination of specific locations.

The surveyor may be called on to determine heights and distances; to set out buildings, bridges and roadways; to determine areas and volumes and to draw plans at a predetermined scale.

Importance of the Surveying

Land surveying is basically an art and science of mapping and measuring land. The entire scope of profession is wide; it actually boils down to calculate where the land boundaries are situated. This is very important as without this service, there would not have been railroads, skyscrapers could not have been erected and neither any individual could have put fences around their yards for not intruding others land.

Surveyors make precise measurements to determine property boundaries. They provide data relevant to the shape and contour of the Earth's surface for engineering, mapmaking, and construction projects.

1.2 Duties/REQUIREMENTS

Surveyors typically do the following:

- Measure distances and angles between points on, above, and below the Earth's surface
- Travel to locations and select known reference points to determine the exact location of important features
- Establish stake sites and official land and water boundaries

- Research land records, survey records, and land titles
- Look for evidence of previous boundaries to determine where boundary lines are located
- Record the results of surveying and verify the accuracy of data
- Prepare plots, maps, and reports
- Present findings to clients, government agencies, and others
- Take notes of land for deeds, leases, and other legal documents
- Provide expert testimony in court regarding survey work

Surveyors provide documentation of legal property lines and help determine the exact locations of real estate and construction projects. For example, when property, such as a house or commercial building, is bought or sold, it may need to be surveyed to prevent boundary disputes. During construction, surveyors determine the precise location of roads or buildings and proper depths for building foundations. The survey also shows changes to the property line and indicates potential restrictions on the property as far as what can be built on it. In their work, surveyors use Global Positioning System (GPS), a system of satellites that locates.

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1,_____is the process of determining the relative position of natural and man- made features on or under the earth's surface

A. Surveying B Land surveying C. A. & B

2_____ is basically an art and science of mapping and measuring land.

A. concept of Surveying B Land surveying C. A. & B

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

.

Score = _____

Rating:

Information Sheet- 2	Adhering to OH&S requirements associated with leveling activities, and the workplace environment

2.1 concept OH&S requirements

Occupational Health and Safety implementation in organization creating a safe work environment that promotes health and safety practices and that seeks to prevent the occurrence of hazards associated with work and the work environment, reduces exposure and mitigates effects of hazards as far as reasonably practicable.

This deals with the skills and knowledge required to effectively perform work activities to conform to Occupational Health and Safety requirements, and applies to all individuals adhering to Quality assurance requirements.

2.2 DEFENATION OF SEFTY

What is safety'?

We use the word 'safety' so much, often in company with its partner 'health', that it should be easy to find a definition. Yet the dictionaries do not offer much assistance safety [is] the absence of danger' one says, unhelpfully supplying the entry for 'danger' as 'absence of safety'! Others suggest a state of protection' and 'a condition not involving risk'. Perhaps the best we can do is to agree that there is no arbitrary state of 'absolute safety', as there is always a chance a risk of something going wrong, however small that chance may be.

SAFETY MANUAL

- Each field employee shall have ready access to the "Safety Manual for Field Survey Personnel"
- No survey operation shall be considered as either so important or so urgent that the Safety Manual or any Safe practice will be compromised.

RESPONSIBILITIES

1. Individuals

a. All field personnel shall have a practical working knowledge of the Safety Manual.

b. Each employee will do everything reasonably necessary to protect life, safety, and health of everyone and comply with all occupational safety and health regulations that are applicable to his job.

c. Each employee shall report to work each day in an alert, agile and capable condition. You should be:

- **Healthy** - If you are ill, do not report to work. If you become ill on the job, do not continue to work. Report to your supervisor and then get aid.
- **Rested and Nourished** - Each surveyor must report for work prepared to perform an alert, accident-free, full shift of work. For most individuals this dictates 7 to 8 hours of sleep and a nourishing breakfast.
- **Free From Influence of Drugs or Alcohol** –
- **Drugs** - Whenever a physician gives you a prescription, inquire if the drug might impair your safe functioning. If any impairment might result, ask the doctor what you can and cannot do while taking the medication. Notify your supervisor. Do not report for work if you are under the influence of non-prescribed narcotics. Also do not report for work if you have been taking any drugs, prescribed or otherwise, which diminish your alertness and your ability to react quickly and make sound judgments.
- **Alcohol** - Do not report for work if you are under the influence of intoxicants. Also, do not report for work if any lingering effects from drinking intoxicants (such as a "hangover") would diminish your alertness and keep you from reacting quickly or would impair your judgments.

2. Area Engineers - The Area Engineers are responsible for:

- Monitoring safety conditions and performance of survey crews working on their projects.
- Reviewing with the Party Chief the planning of all surveys Planning shall
- **Include:**
- The safest time of day that the survey can be accomplished.
- The optimum number of personnel to do the job.
- The assignment of trained and qualified personnel for the more hazardous jobs.
- **3. Party Chiefs** - Each Party Chief is responsible for the work methods and safety practices of his party. The Party Chief is in the best position to see that all safety rules and procedures are followed and that all Work is performed safely. Do not attempt to delegate this responsibility.

The Party Chief must ensure the use of the one best SAFE method for each operation.

- **Safe Surveying Practices**

✓ See that a copy of the Safety Manual is always available to members of your party

✓ Enforce all elements of the Safety Manual

✓ Monitor employees for drug and alcohol abuse.

- **Job Planning**
  - Give safety first priority in planning each survey.
  - As required for each job, develop additional safety practices.
  - Request enough personnel for safe surveying: for buddies, lookouts, flagman, etc.
  - Insofar as possible, plan around hazards, especially life-threatening hazards such as traffic.
  - Avoid assigning party members to solo-type tasks that isolate them from other party personnel.

Try to have each member working with a buddy. (This is especially important in high hazard areas, such as along roads and mountain areas.)

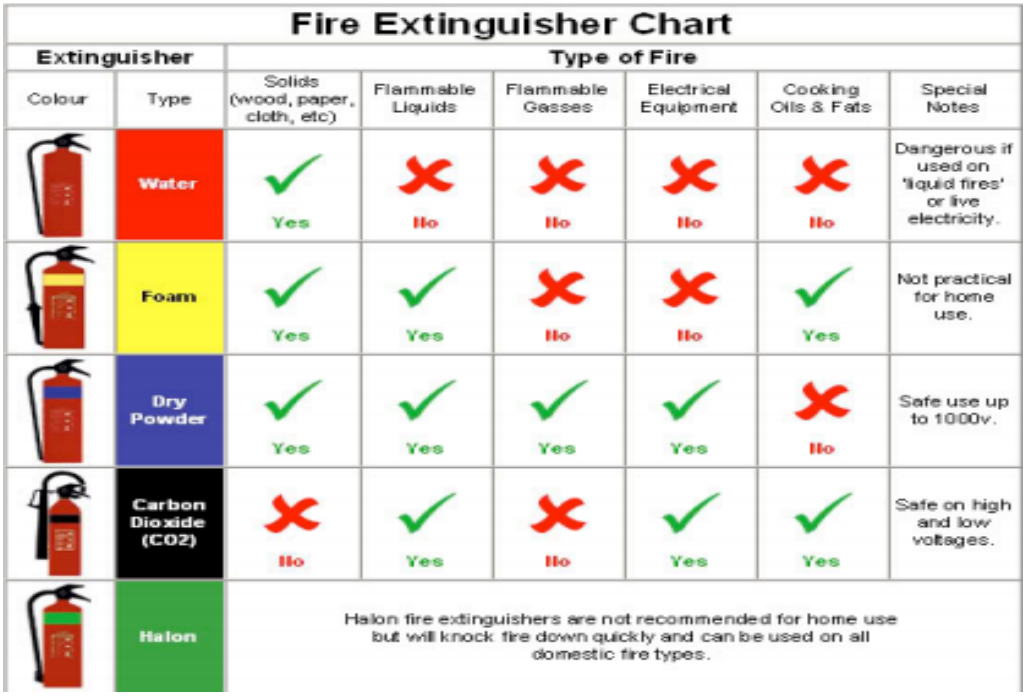
Personal Equipment - See that each subordinate possesses or has available required personal safety equipment. You must see that employees use this equipment as required. If an employee refuses to use required equipment, do not allow him to work. Dismiss him, without pay, for the rest of the day. Refer the matter to your supervisor.

- **Party Equipment** - See that equipment and supplies are safe to use.
- **New Employees**
  - Show the employee where the Safety Manual, first aid kit, fire extinguisher, safety
  - Flares, etc. is stored.
  - Adequately orient and begin training the new employee in required work tasks before allowing him to work alone at individual tasks.
  - Appraise the driving abilities of each new employee before allowing the employee to operate a State vehicle.

NOTE: The appropriate Assistant Division Chief is to notify the Party Chief if the new Employee has any driving restrictions.

Handling of materials or 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?
-
- **Use of firefighting equipment**
- Fire is a form of a chemical reaction that involves the rapid oxidation of combustible fuel (material) with the subsequent liberation of heat and light.



Fire Extinguisher Chart							
Extinguisher		Type of Fire					
Colour	Type	Solids (wood, paper, cloth, etc)	Flammable Liquids	Flammable Gasses	Electrical Equipment	Cooking Oils & Fats	Special Notes
	Water	✓ Yes	✗ No	✗ No	✗ No	✗ No	Dangerous if used on 'liquid fires' or live electricity.
	Foam	✓ Yes	✓ Yes	✗ No	✗ No	✓ Yes	Not practical for home use.
	Dry Powder	✓ Yes	✓ Yes	✓ Yes	✓ Yes	✗ No	Safe use up to 1000v.
	Carbon Dioxide (CO2)	✗ No	✓ Yes	✗ No	✓ Yes	✓ Yes	Safe on high and low voltages.
	Halon	Halon fire extinguishers are not recommended for home use but will knock fire down quickly and can be used on all domestic fire types.					

Figure 2.1 firefighting equipment

PERSONAL SAFETY AND FIRST AID

- ✓ Accident will happen on building site, but developing the skills that you need to does your work safely can reduce the number.
- ✓ People disregarding the recommended procedure generally cause for accidents.
- ✓ While performing an activity you should concentrate on your work.

FIRST AID

- A building site or workshop should have a first aid box, which at least contains the following:-

1. Plasters
2. Bandages
3. Ointment

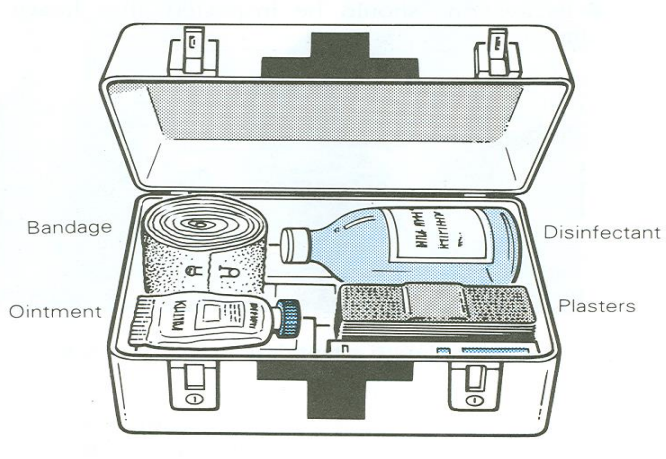


Figure 2.2First aid kit

Self-Check -2	Written Test

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

1, what doth mean Safe Surveying Practices?

2, what is meaning safety?

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 5 points**

Score = _____

Rating: _____

Information Sheet-3	Adhering to Quality assurance requirements

3.1 Quality assurance:-

Requirements are identified and adhered to in accordance with workplace requirements

Quality assurance: - All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

Quality control: -The operational techniques and activities that are used to fulfill requirements for quality. Or it may also be defined as: a system for insuring quality of output involving inspection, analysis, and action to make required changes.

Quality management: - That aspect of the overall management function that determines and implements the quality policy

Quality system: - The organizational structure, responsibilities procedures, processes and resources for implementing quality management

Record: - A document, which furnishes objective evidence of activities, performed or results obtained process.

Inspection & test plan: - A document, which identifies the inspection, testing/verification and acceptance requirements for each activity of the construction

Quality policy:-The Quality policy of a company/organization bases itself on its mission statement, goals and objectives in that quality of the buildings is priority and nonnegotiable.

e.g.:- Insure the quality of the houses to be built consistently by preparing accurate and to the standard designs, as poor designs can never result in a high quality product implementing the same with the use of approved material, appropriate equipment and competent workmanship to meet the minimum quality requirements specified therein with a minimum possible cost and without affecting health, safety and environmental consideration.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1, ----------is all those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.

A Quality assurance C Quality management

B Quality control D Inspection & test plan

2, which are operational techniques and activities that are used to fulfill requirements for quality?

A Quality assurance C Quality control

B Quality management D Inspection & test plan

Note: **Satisfactory rating – 3 and 4 points** **Unsatisfactory - below 3 and 4 points**

.

Score = _____

Rating: _____

Information Sheet-4	selecting Tools and equipment & personal safety equipment

4.1 selections of Tools and equipment

- ✓ Selection of tools and equipment is depends on the which is performed
- ✓ Tools – is small material which we use to do something.

1. **Arrows (chain pin)** - they are used to mark the position of survey station or the point of the tape on ground. Helps for temporary.

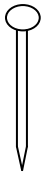


Figure 4.1 Arrows (chain pin

2. **Peg**

Wooden pegs are used to mark the position of the survey station. Helps for permanent.

Figure 4.2 Peg

3. **Profile Boards**

Profile Boards are used to determine the vertical alignment of a road section. The profile board is designed in such a way that it can be attached to a ranging rod. It has a screw mechanism that enables the profile board to slide up and

down the ranging rod and be fixed at any desired level by tightening the screw. A long-lasting profile board is made from thin steel plate welded to a short length of metal tubing that can slide up and down and be clamped to the ranging rod. A useful size for the metal profile board has been found to be40cm by 12cm. It is painted red to make it easy to see.

Figure 4.3 Profile Boards

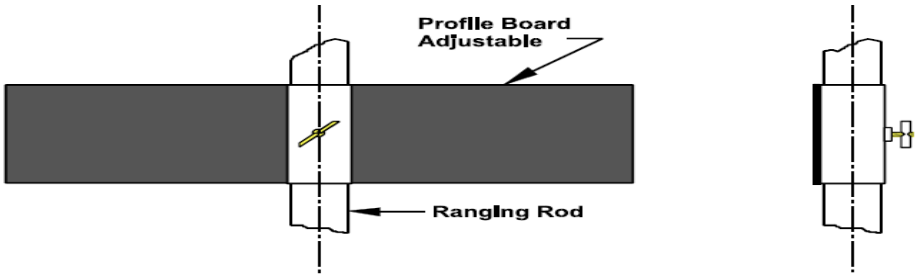


Figure 4.4

4. **Leveling Rod (staff)**
   - ✓ Its surveying tools help as to read the elevation of the ground with leveling instrument.
   - ✓ Its graduated over its surface
   - ✓ Its length (height) is up to 8m.

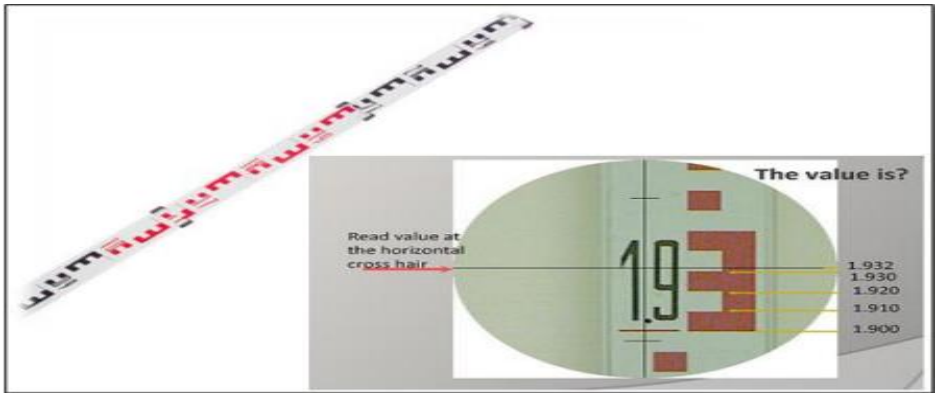


Figure 4.5 4. Leveling Rod (staff)

5, Chain:-The chain is usually made of steel wire, and consists of long links joined by shorter links. It is designed for hard usage, and is sufficiently accurate for measuring the chain lines and offsets of small surveys.

Figure 4.6 Chain

Chains are made up of links which measure 200mm from center to center of each middle connecting ring and surveying brass handless are fitted at each end. Tally markers made of plastic or brass are attached at every whole meter position or at each tenth link. To avoid confusion in reading, chains are marked similarly form both end (E.g. Tally for 2m and 18m is the same) so that measurements may be commenced with either end of the chain

6, Tapes: Tapes are used where greater accuracy of measurements are required, such as the setting out of buildings and roads. They are 15m or 30m long marked in meters, centimeter and millimeters. Tapes are classified into three types;

Figure 4.7 Tapes and role

i. **Linen or Linen with steel wire woven into the fabric;** These tapes are liable to stretch in use and should be frequently tested for length. They should never be used on work for which great accuracy is required.

ii. **Fiber Glass Tapes:** These are much stronger than lines and will not stretch in use.

iii. **Steel tapes:** These are much more accurate, and are usually used for setting out buildings and structural steel works. Steel tapes are available in various lengths up to 100m (20m and 30m being the most common) encased in steel or plastic boxes with a recessed winding lever or mounted on open frames with a folding winding lever.

6 Ranging Rod:

Figure 4.8 Ranging Rod

These are poles of circular section 2m, 2.5m or 3m long, painted with characteristic red and white bands which are usually 0.5m long and

tipped with a pointed steel shoe to enable them to be driven into the ground. They are used in the measurement of lines with the tape, and for marking any points which need to be seen.

7. Staff Bubble

These are generally a small circular bubble on an angle plate which is held against one Corner of the staff to ensure that the staff is held in a vertical position. If the staff is not held vertical, the reading will be too large and may be significantly in error a staff bubble shall be used at all times. If one is not available, the "chainman" (staff operator) shall rock the staff slowly back and forth about the vertical in a line towards the instrument. The observer notes the smallest reading which will occur when the staff is vertical

Figure 4.9 Staff Bubble

8, Plumb Bob:-it is used to find the center point of the tripod or instrument set up place.

Figure 4.10 Plumb Bob

4.2 Equipment or Instrument

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

4.2.1 Modern Tilting Level

Small up/down motion of telescope is possible. Adjustment of level bubble Needed before measurement this type of level is fitted with a circular bubble for preliminary approximate leveling and a main bubble which is attached to the telescope. For each observation (not setup) the main bubble is viewed through an eyepiece and the telescope tilted by a fine screw to bring the two ends of the bubble into coincidence

Figure 4.11 Modern Tilting Level

4.2.2 Dumpy Level

Levels by the help of bubble tube. Adjustment of level bubble needed only once after level set up These are more basic levels often used in construction work. The telescope is rigidly attached to a single bubble and the assembly is adjusted either by means of a screwed ball-joint or by foot screws Which are adjusted first in one direction, then at 90°

Figure 4.12 Dumpy Level

4.2.3 Automatic Level

Automatic Level

- Automatic levels-Levels automatically by compensators. Self-leveled instruments
- An automatic level, self-leveling level or builder's auto level, includes an internal compensator mechanism (a swinging prism) that, when set close to level, automatically removes any remaining variation from level
- This reduces the need to set the instrument truly level, as with a dumpy or tilting level. Self-leveling instruments are the preferred instrument on building sites, construction and surveying due to ease of use and rapid setup time
- This more modern type of level is now in general use. It has a compensator which consists of an arrangement of three prisms. The two outer ones are attached to the barrel of the telescope. The middle prism is suspended by fine wiring and reacts to gravity. The instrument is first leveled approximately with a circular bubble; the compensator will then deviate the line of sight by the amount that

the telescope is out of level

Figure 4.13 Automatic Level

4.2.4 Tripods

A tripod for supporting the leveling instrument

Tripods provide a fixed base for all types of surveying instruments and sighting equipment. Instrument manufactures nave standardized surveying tripods

Figure 4.14 Tripods

4.2.5 Optical Square:

This instrument is used for setting out lines at right angle to main chain line. It is used where greater accuracy is required. There are two types of

optical square, one using two mirrors and the other a prism.

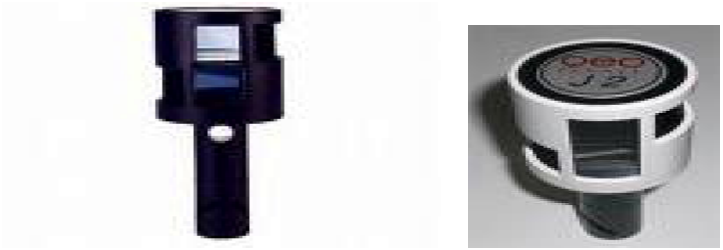


Figure 4.15 Optical Square

- The mirror method is constructed based on the fact that a ray of light is reflected from a mirror at the same angle as that at which it strikes the mirror.
- The prism square method is a simplified form of optical square consisting of a single prism. It is used in the same way as the mirror square, but is rather more accurate.

The observer can see both point B, through a narrow opening left in the optical, square and point C in the mirror or prism.

When two ranging rods are placed at points B and C, the observer will see ranging rod B direct and ranging rod C reflected as illustrated in the figure below.

When points A and B on the survey line are known and point C has to be found, as shown in the figure above, the person holding ranging rod C should move forwards or backwards until the observer see the reflection of rod C in one line with his direct view of rod B. At this point angle CAB, is now at a right angle.

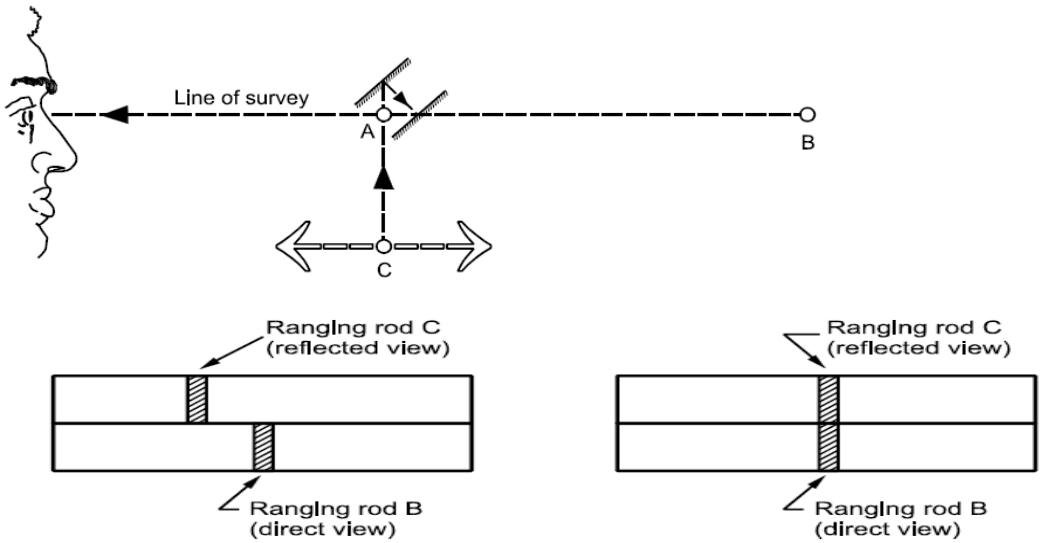

Line of survey
A
B
C
Ranging rod C
(reflected view)
Ranging rod B
(direct view)
Ranging rod C
(reflected view)
Ranging rod B
(direct view)

Figure 4.16

Self-Check -4	Written Test

Directions: Answer all the questions listed below.:

1,_____are used to mark the position of survey station or the point of the tape on ground helps for temporary?

A, staff B, Arrows C, Peg D, ALL

2, which surveying tools help as to read the elevation of the ground with leveling instrument.

A, staff B, Tripod C, Profile Boards D, ALL

3, _____is levels automatically by compensators?

A, Modern Tilting Level B, Automatic Level C, Dumpy Level D, ALL

II Say True or False

1, Tripod is providing a fixed base for all types of surveying instruments and sighting equipment.

2, Small circular bubble used on an angle plate of the staff to ensure that the staff is held in a vertical position.

Note: **Satisfactory rating – 3 points** **Unsatisfactory - below 3 and 4 points**

Score = _____

Rating: _____

List of Reference Materials

1. Basic Civil Engineering (S.S BHAVIKATTI) New Age International Publisher
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3. Advanced concrete technology edited by John Newman Ban Seng Choo.
4. Ethiopian Building Code Of Standard (EBCS 2/1995)
5. Fundamentals of land surveying
6. Surveying - Bannister & Raymond 6th Edn.
7. Engineering surveying, W. SCHOFIELD AND M. BREACH, SIXTH EDITION.
8. Surveying (Edn5) - Kavanagh & Bird
9. Teaching methodology learning material

Plumping installation
Level-II

Learning Guide-39

Unit of Competence: Carry-Out Basic Leveling

Module Title: Carrying-Out Basic Leveling

LG Code: EISPLI2 M09 LO2-LG-39

TTLM Code: EISPLI2 M09TTLM 0919v1

LO 2: Perform leveling

Instruction Sheet	Learning Guide # 39

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

- Identifying Height to be transferred
- Setting up Leveling equipment
- Operating Laser levels
- Shutting, recording and marking Levels shot

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 Height to be transferred
- Set up Leveling equipment
- Operate Laser levels
- Shut, record and mark Levels shot

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 and, Sheet 4
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 2 and Operation Sheet 4”
6. Do the “LAP test” (if you are ready).

Information Sheet-1	Identifying Height to be transferred

1.1 concept of leveling

Leveling is a type of surveying which is carried out for measuring the elevation of ground points or near to it and to establish the elevation or heights of ground points which are vital for engineering design. The elevation of points or heights of points is defined as its vertical distance above or below a given reference, Level surface, Datum.

i) To find the elevations of given points with respect to a given or assumed datum

ii) To establish points at a given or assumed datum.

The first operation is required to enable the works to be designed while the second operation is required in the setting out of all kinds of engineering works. Leveling deals with measurements in a vertical plane.

The elevation or height of point has been defined as its vertical distance above or below a given reference. Generally leveling is a vital operation producing necessary data for mapping, engineering design and construction.

Leveling results are used to:

- Design high ways, railways & canals having grade lines that best conform to the existing topography.
- Layout construction works or projects according to planned elevations.
- Calculate volumes of earth work.
- Investigate drainage characteristics of an area.
- Develop maps showing general ground configuration.
- Determine the height (altitude) of the ground at a number of points along any desired lines so that sections may be drown.
- To set out level or horizontal surface such as floor slabs, foundation trenches and machine bases etc.

The basic cycle of differential leveling can be summarized as follows:

Height of Instrument = Known elevation + back sight

HI = ElevA + BS

New elevation = height of instrument – foresight

ElevB = HI - FS

Example

Elv of B = elv of A ± (HA-HB)

= 1235.53 – 0.59

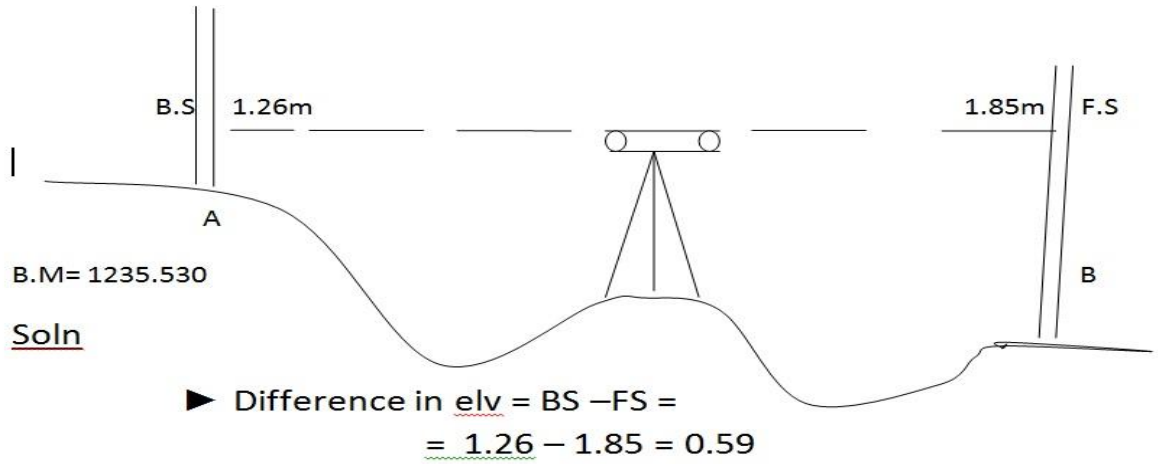
= **1234.940m**

► Check

☞ BS – FS = Last Rl –first Rl

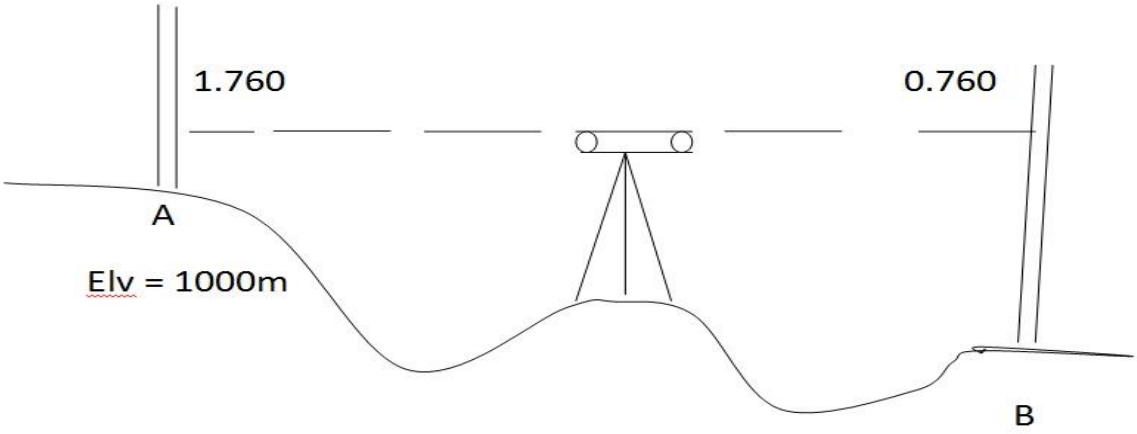
☞ 1.26 – 1.85 =1234.94 -1235.53

☞ **0.59** = **0.59**



Exercise: 1- calculate

A. Difference in elv
B. Determine elv of B
C. State the ground is uphill or downhill
D. check



Solution

1. Difference in elv
► BS – FS = 1.760 – 0.760 = 1m(rise)
2. Elv B
► Elv A ± (BS – FS)
► 1000 ± (1.760 -0.760)

► 1000 + 1 = **1001m**

3. Uphill, b/c BS> FS
4. Checking

► BS – FS = Last Rl –first Rl
► 1.760 – 0.760 = 1001 - 1000
► **1** = **1**

Definitions & Terminologies

Level surface: A level surface is defined as a curved surface which at each point is perpendicular to the direction of gravity at the point. The surface of a still water is a truly level surface. Any surface parallel to the mean spheroidal surface of the earth is, therefore, a level surface.

Level line: A level line is a line lying in a level surface. It is, therefore, normal to the plumb line at all points.

Horizontal plane: Horizontal plane through a point is a plane tangential to the level surface at that point. It is, therefore, perpendicular to the plumb line through the point.

Horizontal line: It is a straight line tangential to the level line at a point. It is also perpendicular to the plumb line.

Vertical line: It is a line normal to the level line at a point. It is commonly considered to be the line defined by a plumb line.

Datum: Datum is any surface to which elevation are referred. The mean sea level affords a convenient datum world over, and elevations are commonly given as so much above or below sea level. It is often more convenient, however, to assume some other datum, specially, if only the relative elevation of points are required.

Elevation: The elevation of a point on or near the surface of the earth is its vertical distance above or below an arbitrarily assumed level surface or datum. The difference in elevation between two points is the vertical distance between the two level surface in which the two points lie.

Vertical angle: Vertical angle is an angle between two intersecting lines in a vertical plane. Generally, one of these lines is horizontal.

Mean sea level: It is the average height of the sea for all stages of the tides. At any particular place it is derived by averaging the hourly tide heights over a long period of 19 years.

Bench Mark: It is a relatively permanent point of reference whose elevation with respect to some assumed datum is known. It is used either as a starting point for leveling or as a point upon which to close as a check.

1.2 Methods of leveling

Three principle methods are used for determining differences in elevation, namely, barometric leveling, trigonometric leveling and spirit leveling.

Barometric leveling

Barometric leveling makes use of the phenomenon that difference in elevation between two points is proportional to the difference in atmospheric pressures at these points. A barometer, therefore, may be used and the readings observed at different points would yield a measure of the relative elevation of those points.

At a given point, the atmospheric pressure doesn't remain constant in the course of the day, even in the course of an hour. The method is, therefore, relatively inaccurate and is little used in surveying work except on reconnaissance or exploratory survey.

Figure 1.1 Barometric leveling

Trigonometric Leveling (Indirect Leveling)

Trigonometric or Indirect leveling is the process of leveling in which the elevations of points are computed from the vertical angles and horizontal distances measured in the field, just as the length of any side in any triangle can be computed from proper trigonometric relations. In a modified form called stadia leveling, commonly used in mapping, both the difference in elevation and the horizontal distance between the points are directly computed from the measured vertical angles and staff readings.

Spirit Leveling (Direct Leveling)

It is that branch of leveling in which the vertical distances with respect to a horizontal line (perpendicular to the direction of gravity) may be used to determine the relative difference in elevation between two adjacent points. A horizontal plane of sight tangent to level surface at any point is readily established by means of a spirit level or a level vial. In spirit leveling, a spirit level and a sighting device (telescope) are combined and vertical distances are measured by observing on graduated rods placed on the points. The method is also known as direct leveling. It is the most precise method of determining elevations and the one most commonly used by engineers.

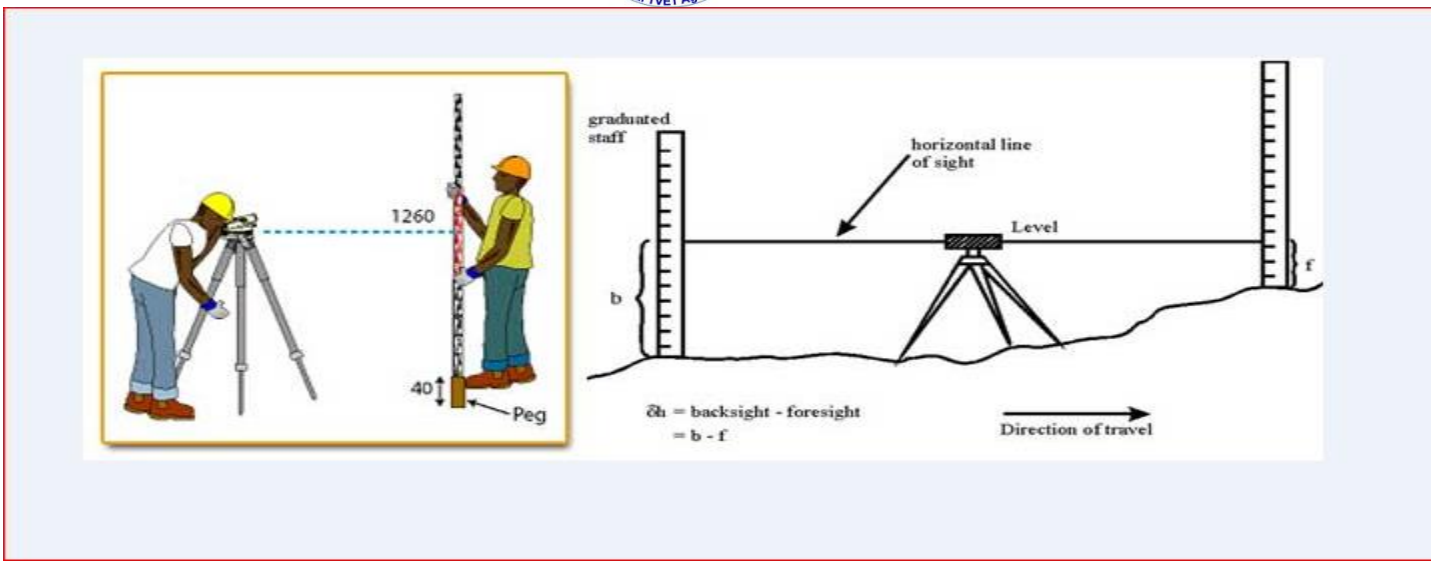


Figure 1.2 Spirit Leveling (Direct Leveling

- How to calculate horizontal distance by using leveling instrument
- Horizontal distance = (upper reading- lower reading)*100

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1. .What is horizontal plane? (5 points)
2. What is level line? (5 points)
3. What is leveling? (5 points)

Note: **Satisfactory rating - 15 points** **Unsatisfactory - below 14 points**

.

Score = _____

Rating: _____

Information Sheet-2	Setting up Leveling equipment

2.1 Setup the leveling instruments

Leveling Instrument Set- Up

a. Setting up tripod

1. Loosen screws of tripod legs, pull out to required length and tighten screws.
2. In order to guarantee a firm foothold sufficiently press the tripod legs into the ground. When pressing the legs into the ground notes that the force must be applied along the legs.
3. Check all screws and bolts for correct fit.

When setting up the tripod pay attention to a horizontal position of the tripod plate. Minor inclinations of the tripod can be corrected with the foot screws of the tri branch.

4. Place level onto tripod head. Tighten central fixing screw of tripod. So that the tripod head is approximately horizontal.

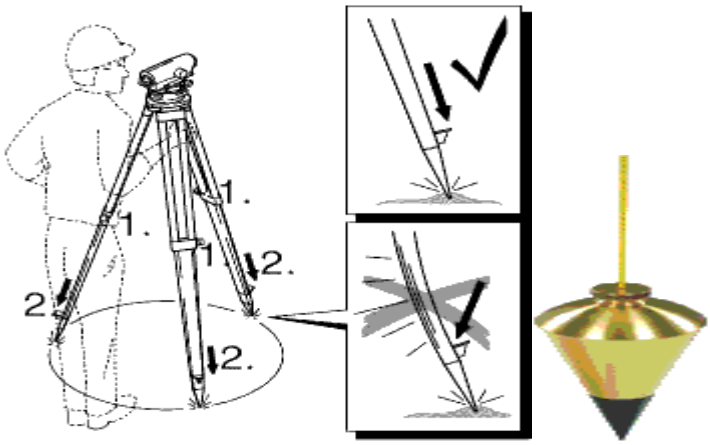


Figure 2.1 Leveling Instrument Set- Up

Set up the tripod where you have a clear sight of the benchmark, at a similar height to but preferably higher, than the benchmark. If possible, set up in the center of the area that you intend to survey, or somewhere that you can see all of the site as well as the back sight/Bench Mark, with the top plate relatively level.

Note: Bear in mind that if at some point you have to move the level (higher or lower, or to a new location) you will need to re-level it and retake the back sight reading.

4. If you want to center an instrument over a ground point:

1. Attach plumb bob and arrange the tripod in such way that the drop is over the point.
2. For fine adjustment loosen central fixing screw slightly and shift instrument parallel on tripod until the plummet is exactly over the point.

3. Tighten central fixing screw.

b. Center the bubble

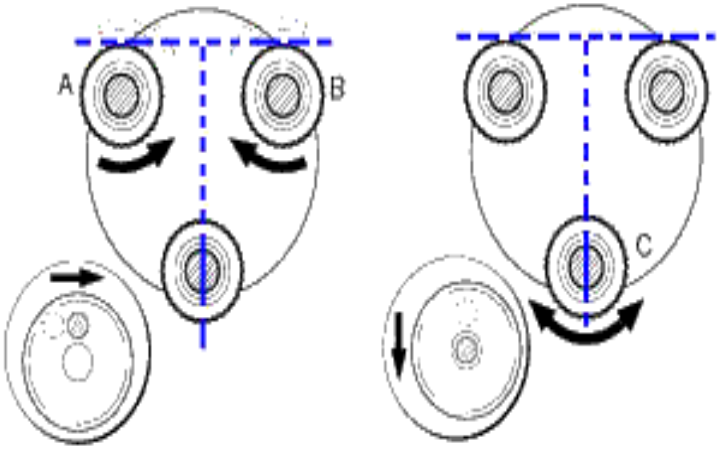


Figure 2.2 Leveling Instrument

c. Targeting d. Focusing

I. Turn foot screws A and B simultaneously in opposite directions until bubble is in the center (on the imaginary "**T**").

II. Turn the instrument 90° and then turn the foot screw C until bubble is centered

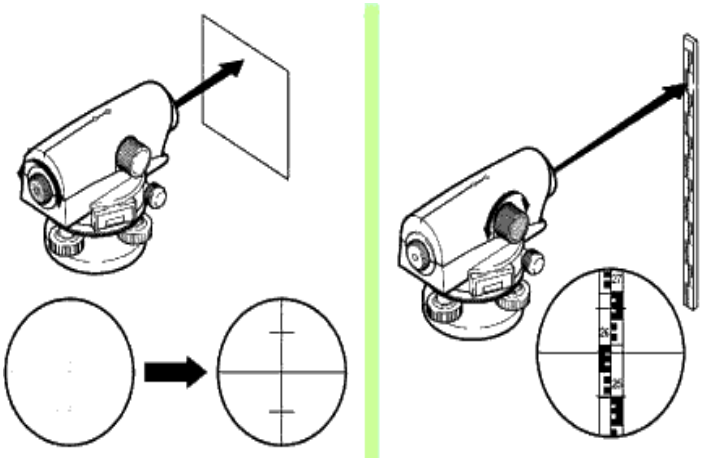


Figure 2.3 Targeting and Targeting

- Aim telescope against a bright background

Turn eyepiece until reticule is sharp-focused and deep black. Now the eyepiece is adapted to your eye.

- Turn focusing knob until image of staff is sharply focused.

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, lastly targeting & Focusing.

Spread the tripod ⟶ Center the ⟶ Targeting⟶ Focusing.

Self-Check -2	Written Test

Directions: Answer all the questions listed below.

. Choose the Best Answer

_____1. Surveyor takes the following reading of leveling on the field, which one of the staff readings shows lower point?

A. 3.75m C.0.85m

B. 2.75m D. 0.05m

_____2.The reading you take to complete your leveling work is

A. Back sight (BS) C. Intermediate sight (IS)

B. Fore sight (FS) D. All

_____3. is the method of direct leveling work, the objective of which is solely to determine the difference in elevation of two points regardless of the horizontal position.

A. Profile leveling C. Cross-section leveling

B. Differential leveling D. None

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

Score = _____

Rating: _____

operation sheet #2	Setting up leveling instrument

General procedure for setting up leveling instrument:

Step 1.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 centralize the circular bubble
Step 6.Test to see if the compensator is working
Step 7.Remove parallax

Information Sheet-3	Operating Laser levels

3.1Operating Laser levels

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

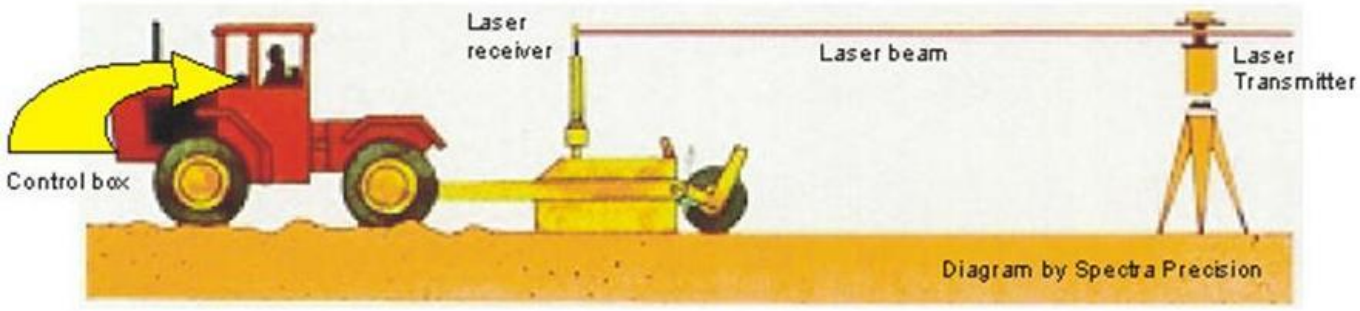


Figure 3.1

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

The concept of a laser level has been around since at least the early 1970s. the original spinning-mirror design laser plane and line level was patented by the late 1980 and the compact lens-based laser line level (as produced by many tool manufacturers today) was patented in the late 1990s.

3.2 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. 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.

3.3 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

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. What is laser leveling? (**10 points**)

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

Score = _____

Rating: _____

Information Sheet-4	Shutting, recording and marking Levels shot

4.1 Concept of Shutting, recording and marking Levels shot

Precision of leveling

As with all techniques used in engineering surveying it is important to estimate how accuracy of the measurements taken.

An assessment of the quality of leveling can be made by calculating the mis closure for a line of levels. This is determined by comparing the reduced level of the closing bench mark with the level obtained for it by calculation from the staff readings.

On construction sites and other engineering projects, leveling is usually carried out over short distances and it can involve a lot of instrument positions. The allowable misclosure for a line of levels is given by:

Allowable miss closure = $\pm m\sqrt{n}$

Where, *m* is a constant and *n* is the number of instrument positions used.

The value most often used for *m* is 5mm

However, most levels are not in perfect adjustment and when leveled their line of sight is never exactly horizontal. If the line of sight is not horizontal when the instrument has been leveled, the level has a collimation error.

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 *L*m 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 leveled. A leveling staff is placed at A and B and staff readings *S*1 (at B) and *S*2 (at A) are taken.

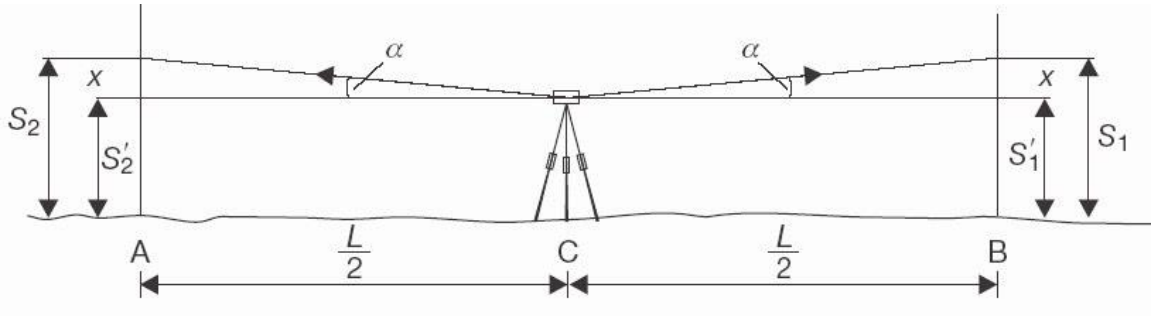


Figure **4.1**

The two readings are:

*S*1 = (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.

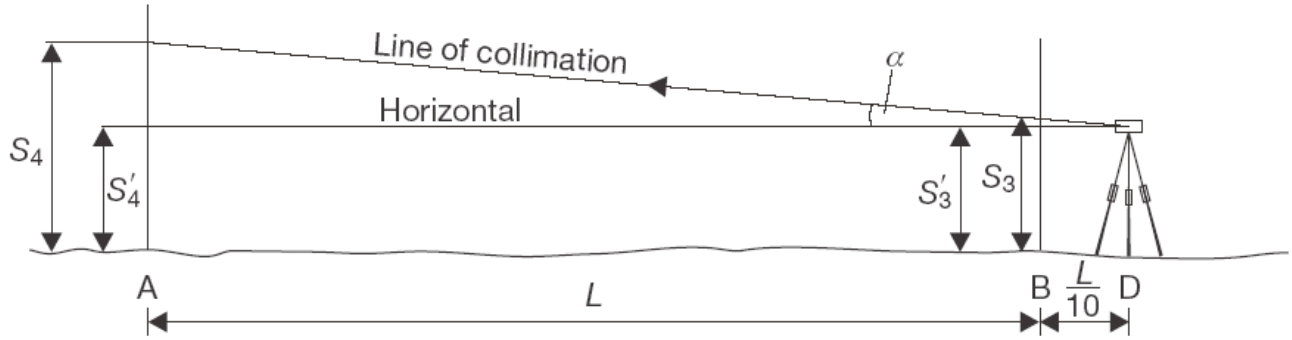


Figure 4.2

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

- **Reading Vertical Distances**

The method of determining the elevation difference between points is that, after the instrument is set up, the readings are taken on the staff that is vertically held on the point & then shifting the staff to the next point that is going to be determined. Hence the elevation difference can be calculated as First staff reading minus second, second minus third staff reading at a single set up.

4.2 Leveling Methods

There are different methods of Leveling like

- ✓ Differential Leveling
- ✓ profile Leveling
- ✓ Cross- Sectional Leveling

Differential Leveling- It is the method of direct leveling, the objective of which is solely to determine the difference in elevation of two points regardless of the horizontal position of the points with respect of each other. When the points are apart, it may be necessary to set up the instruments several times.

The operation of leveling to determine the elevation of points at some distance apart is called differential leveling and is usually a accomplished by direct leveling. The difference in elevation may not found by single setting but the distance b/n the points is divided in to two or three steps or stages by forming or establishing temporary points as turning points on which the staff is held and the difference of elevation of each of succeeding points.

4.3 Leveling Field books

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

- ✓ Rise & Fall method
- ✓ Height of collimation method.

4.3.1Rise and Fall Method

Each reading is entered on a different line in the applicable column, except at change points where a four-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 rise on the ground b/n the points, similarly of a negative result id obtained a fall on the ground can be conclude.

The checks are:

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

Choking levels (Arithmetic check)- 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			

Table 4.1

∑ 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.

4.3.2 Height of Collimation Method

In these 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.

Exercise- 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 & eight readings, these readings will be entered in the F.S column & therefore, 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			

Table 4.2

∑ 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		

Table 4.3

∑ 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

4.4 Profile- Leveling

Profile leveling or longitudinal section is a type of leveling it is used to determine the elevations of the ground surface along some definite line or along a particular line that is the center line of existing or proposed work. Before designed a profile of the existing grand is necessary.

The route along which the profile is run may be a single straight line; as in the case of a short side walk; a broken line as in the case of a transmission line or sewer; or a series of straight line connected by curves as in the case of a railroad, highway, or canal.

In general profile leveling is a longitudinal sectional view showing the undulation (ups & downs) of the ground surface along a given line.

When the profile is plotted the profile is used for many purposes like:-

- ✓ Determining depths of cut & fill on the proposed center line. (Earth work, volumes)
- ✓ For studying gradient or grade lines
- ✓ Investigating and selecting the most economical grade, location & depth for sewer, pipe lines etc.

The general procedure of field work in profile leveling are

1. The center line of the prorated alignment is marked ground; points at equal generals say 20 or 30m are marked. In addition to these required points, other representative points.
2. The instrument is set up at some suitable position so as to command the maximum number of point.
3. A back sight is taken on the B.M.
4. The staff is then kept on the points previously marked and all these points or observations are entered as the intermediate sights.
5. When changing the instrument station for further observations a foresight is taken on the turning point.
6. In plotting the profile, Horizontal distance is marked on a horizontal line, A datum line is selected, the height of points are written against the points. Then the points

laying on the profile is plotted against with respect to the horizontal scale. Normally the horizontal scale is kept in 1:1000 to 1:2000 & the vertical scale is exaggerated when compared with horizontal scale & 1:100 to 1:200

Station	Chainase	B.S	I.S	F.S	H.C	R.L	Roman
B.M		3.56			2503.56	2500	BM
1	0+00		3.08			2500.48	
2	0+20		2.85			2501.71	
3	0+40		2.98			2500.58	
4	0+60		3.17			2500.58	
5	0+80	2.64		3.01	2503.19	2500.55	T.P
6	0+100		2.92			2500.27	
7	0+120		2.98			2500.11	
8	0+140			1.45		2501.74	

Table 4.4

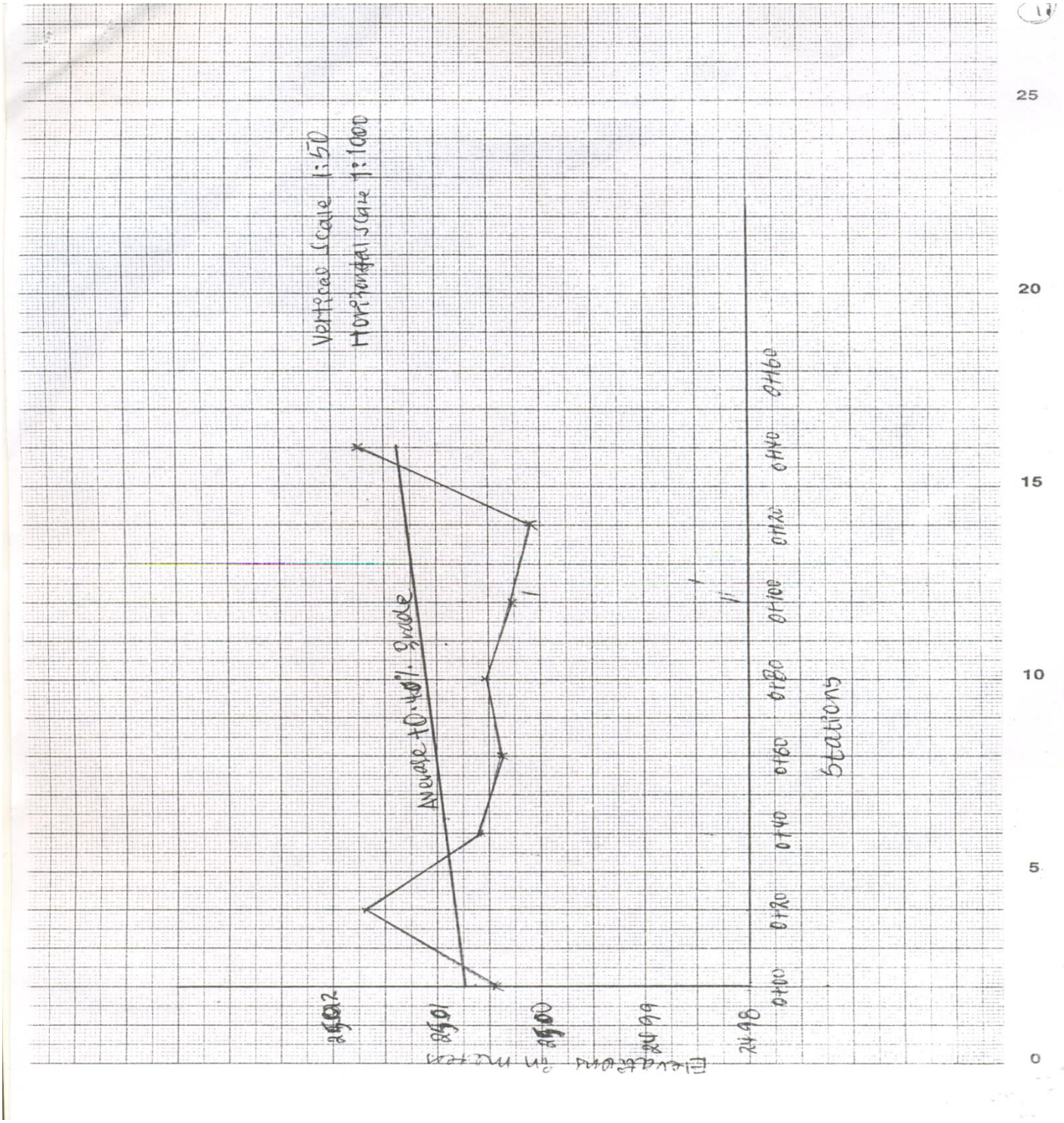


Figure 4.3

When the above data is plotted the profile of the ground at each station is as follows:-

Depths of cut		0.86						0.39
Depth of fill	0.27		0.32	0.61	0.71	0.93	1.19	
Design/Formation) level	2500.75	2500.85	2500.90	2501.00	2501.10	2501.20	2501.30	2501.35
Original ground level	2500-48	2501-71	2500-58	2500-39	2500-55	2500.27	2500.11	2501.74
Cumulative distance	0+00	0+20	0+40	0+60	0+80	0+100	0+120	0+140
Station	1	2	3	4	5	6	7	8

The rate of grade (gradient or percentage grade) is the rise or fall in meters per 100m. For example the aviaries gradient for the above Formation level is + 0.40% i.e the elevation difference b/n the station 0+00 & 0+100 is 0.40m. Generally ascending grades are plus (+) sign & descending grades or down ward grades are minus (-).

Calculation of Formation level

Table 4.5

If the ground level is higher than the proposed level or formation level there must be cutting & where the proposed level exceeds the surface level, filling will be required.

Example:- at station 0+00- the proposed level is higher than the ground level then it will be fill.

- at station 0+20- the proposed level is lower than the ground level, then there will be cutting.

Exercise:- The following data were collected in the field using automatic leveling, then compute the reduced level formation

	Chaiaf	B.S					
BM							
1							
2							
3							
4							
5							
6							

Table 4.6

4.5 Cross-Sectional Leveling

Cross – sectional leveling is a type of leveling which is run at right angles to the longitudinal profile and on either side of it for the pupate of lateral outline of the ground surface. They provide the data for estimating quantities of earth work and for other purposes. The cross-sections are numbered consecutively from the commencement of

the center line and are set out at right angle to the main line of section. The length of cross-section depends up on the nature of the work

Note:- The above figure illustrates the cross-section is taken at interval of 20m which is at right angle to the center that is the longitudinal section.

4.6 Plotting – Cross section

Cross- sections are plotted in a very similar way to that of profile leveling section. One essential difference however, is that the cross-section is plotted to a natural scale that is the horizontal & vertical scales are the same. The points to the left of center point are plotted to the left and those to the right are plotted to right.

Your transit level is no Level staff. A level staff, also called leveling rod, is a graduated wooden or aluminum rod, used with a leveling instrument to determine the difference in height between points or heights of points above a datum surface. It cannot be used without a leveling instrument.

Self-Check -4	Written Test

Directions: Answer all the questions listed below.

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

Note: **Satisfactory rating – 13 points** **Unsatisfactory - below 13 points**

.

Score = _____

Rating: _____

operation sheet #2	Calculate elevation difference and Reduce levels by h.i method

General procedure for measuring elevations using a level:

Suppose that B, C and D are points whose reduced level is to be determined as in Figure 1:

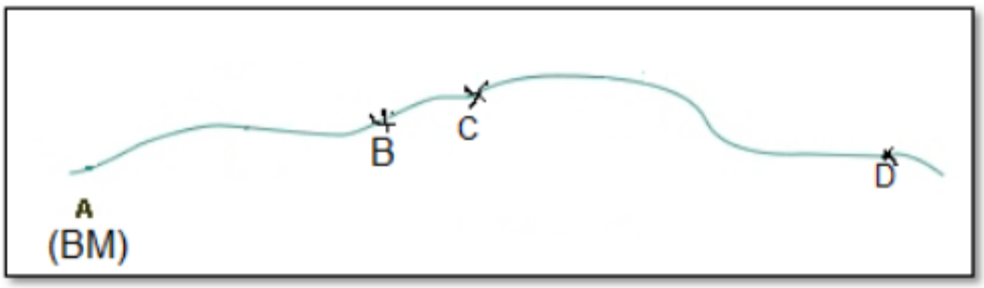


Figure 1: points whose reduced level is to be determined

1. Place the staff over a bench mark (BM), whose reduced level is known, and set up the Instrument in convenient and safe location where the BM (point A) is visible. Take a sight
   on the staff, that reading is called back sight (B.S). See Figure 2
2. Place staff over B. Take a sight on the staff, that reading is called Intermediate sight (I.S). See figure 2
3. Place staff over C. Since the distance between the level and D is long, so it is not possible to read the staff over D from the current level position (pos 1). So take the last reading over C for this position, this will be a foresight (F.S). See figure 2
4. Now, move the instrument to a new position (position 2) and take the reading on the previous position of the staff (over C). This position of staff is known as Turning Point (T.P) and this reading will be back sight (BS). See figure 2
5. Now, shift the staff to the point D and take reading, this reading will be foresight (F.S). See
   figure 2

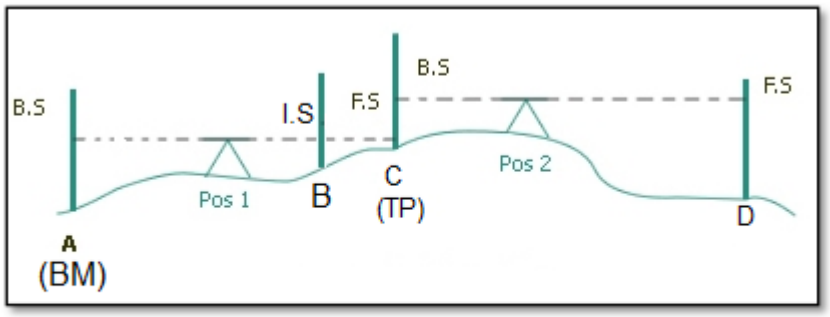


Figure 2: Leveling procedure

- **Tabulation:**

STATION	READINGS			HEIGHT OF INSTRUMENT	REDUCED LEVEL	REMARKS
	B.S	I.S	F.S			

Calculations

1. The height of instrument position(1) can be calculated as:
HI of position 1 = Elevation of BM + BS at BM
2. The reduced level of any point (i) taken from position 1, can be calculated as:
R.L of point i = HI of position 1 – staff reading at point i
3. The height of instrument position(2) can be calculated as:
HI of position 2 = Reduced level of TP1 + BS at TP1
4. The reduced level of any point (i) taken from position 2, can be calculated as:
R.L of point i = HI of position 2 – staff reading at point i
5. And so on….
6. **Checks:** The following checks on the booking and arithmetic calculations are performed:

A) Number of BS readings = Number of FS readings
B) ∑BS - ∑FS = RL of last point – RL of first point

LAP Test # 2	Calculate elevation difference and reduce level by rise and fall method

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 1 hours.

Task 1**: -** set up the leveling instrument properly.
Task 2:- observe the data and record on sheet

Task 3:- calculate

LAP Test # 3	Calculate elevation difference and reduce level by h.i method

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, workshop, tools and materials you are required to perform the following tasks within 1 hours.

Task 1: **-** set up the leveling instrument properly.
Task 2:- observe the data and record on sheet

Task 3:- calculate

List of Reference Materials

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Plumping installation

Level-II

Learning Guide-40

Unit of Competence: Carry-Out Basic Leveling

Module Title: Carrying-Out Basic Leveling

LG Code: EISPLI2 M09 LO3-LG-40

TTLM Code: EISPLI2 M09TTLM 0919v1

LO3: Clean up

Instruction Sheet	Learning Guide # 40

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

- Cleaning, checking, maintaining and storing Tools and equipment
- performing good housekeeping
- Completing documentations

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:

- Clean, check, maintain and storing tools and equipment
- perform good housekeeping
- Complete documentations

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, and Sheet 3.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4”
5. Do the “LAP test” (if you are ready).

Information Sheet-1	Cleaning, checking, maintaining and storing Tools and equipment

1.1 Preparing Tools and Equipment for maintenance and Storing

Keeping tools properly storing, cleaning, and maintaining will save time and money. In order to keep tools in good working condition during storage, there are some basic preparatory steps that should be taken. It is important to follow the cleaning and storage instructions, especially for. Theodolite

3.1.1 Storing tools and equipment's

i. Storing of theodolite

- Store the tripod in preferably in place
- Storing the **theodolite** in dry place

ii. Storage of rang pol and staff

- Store the rang pol and staff

➢ **Storing of tools**

How to Prepare and Store Tools

1. To keep tools tidy, it should be cleaned after use and wiped down with a rag or towel to be sure that they are free of dirt, grease and debris.
2. After cleaning, damage or defects should be checked. If the tool cannot be repaired, it should be thrown to away.
3. Any soil and dirt should be scraped away from the metal surfaces with an approved solution. Before placing in storage it should be dried with a towel or rag.
4. The metal parts of the tools should be coated with a lubricant protector spray.
5. Tools is does not directly stored on the ground both small hand and power tools should be Placed on shelving.
6. Short-handled tools should be stored in a plastic bin or box. All surfaces of Power tools should be cleaned and completely dry before storage and Spraying lubricants

Fig 3.4 Tools Storing board

Self-Check -1	Written Test

Directions: Answer all the questions listed below.

1, keeping tools properly storing, cleaning, and maintaining is **not** saves time and money **(3 points)**

A True

B False

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

Score = _____

Rating: _____

Information Sheet-2	performing good housekeeping

2.1 conspet housekeeping

Good housekeeping involves every phase of construction operations and should apply throughout the entire premises, indoors and out. It is more than mere cleanliness. It requires orderly conditions, the avoidance of congestion, and attention to such details as an orderly layout of the whole workplace, the markingof aisle adequate storage arrangements, and suitable provision for cleaning and maintenance.Efficient production and a good working environment are complement ary. Theelimination of inefficiencies and accident hazards caused by unfavorab le conditions in and about the workplace is essential in getting the job done properly and safely. The attention to these important details—which may be overlooked when management's attention is concentrated upon such amenities as good cloakrooms, canteens, rest rooms, recreational facilities, etc.—is widely referred to as "good housekeeping.A clean, well ordered, attractive work environment sets the tone of your establishment. It encourages tidy work habits in employees. It helps reduce fatigue. It promotes good worker-management relations. It also gives a lift to morale, which is reflected in the quality of production and overall efficiency. Good housekeeping is also a good advertisement for your company. Customers and clients have more confidence in an organization when they we work being carried out efficiently in clean, pleasant, well ordered surroundings. There's an even more important reason why good housekeeping matters — it makes the undertaking a safer place to work in.

Good housekeeping is a vital factor in preventing accidents. The great majority of all work accidents are caused during the handling of goods or materials, and by people falling, being hit by falling objects, or striking against objects in the workplace. All these causes can be reduced by good housekeeping practices in fact; good housekeeping is the only cure for hundreds of accidents that occur. Here are some kinds of accidents commonly caused by bad housekeeping:

Tripping over loose objects on floors, stairs and platforms

Articles dropping from above
Slipping on greasy, wet or dirty surfaces
Striking against projecting, poorly stacked, or misplaced material
Tearing the hands or other parts of the body on projecting nails, wire, steel strapping on bales or crates, etc.
Typical examples of poor housekeeping that lead to these accidents are:
Excessive material, waste or chips in the working area
Congested aisles
Tools left on machines
Waste containers overflowing
Lockers and workrooms in disorder
Acids in open containers
Broken glass
Electric leads or air lines across aisles
Dirty light fittings, windows and skylights

Where housekeeping is bad, fire is a constant hazard. It can be caused by many housekeeping problems such as oil-soaked rags and clothing igniting from spontaneous combustion; dust collectors not being properly or frequently cleaned; or piles of paper and other packing materials being allowed to accumulate. Poor housekeeping can also lead to infestation by pests such as rodents and cockroaches and create serious health risks.

2.2 Elements of a Good Housekeeping
The following are the basic elements of a good housekeeping:
Aisles: Wide enough for traffic movements, marked off by floor lines from work positions and storage areas.
Space: Insuring sufficient room for the individual to work.
Storage: Adequate and convenient space for materials and tools.
Materials Handling: Layout planned for materials flow, with efficient methods and equipment.

Ventilation: Good general ventilation plus local exhaust ventilation to remove air contaminants at the source.

Floors and Walls: They need to be constructed with materials that are easy to clean and if needed easy to repair.

Lighting Welldistributed artificial light and effective use of available daylight.

Amenities: Clean, up-to date washrooms and lockers for clothing, and clean and inviting lunch room for employees to eat their meals.

Waste Removal: Adequate facilities to prevent congestion and disorr.

Self-Check -2	**Written Test**

Directions: Answer all the questions listed below.

1, list elements of a Good Housekeeping

Note: **Satisfactory rating - 25 points** **Unsatisfactory - below 25 points**

Information Sheet-3	Completing documentations

3.1 Define documentation

Documentation – is important for the success of the work safety management system allowing for consistency and uniformity in applying health and safety in the workplace. Typical documents include plans, policies, procedures, guidelines and forms that define the System.

- **A controlled document or record** – any document for which distribution and status are required to be kept current by the issuer to ensure that authorized holders or users have the most up to date version available.
- **Document control** – the process established in this procedure to define controls needed for the management of WHS&IM documentation.
- **Records** –'information created, received, and maintained as evidence and information by an organization or person, in pursuance of legal obligations or in the transaction of business' (AS ISO 15489.1-2002 Australian Standard Records Management Part 1: General). Records of WHS & IM activity are generated as part of university business and reflect what was communicated or decided or what action was taken.
- **Records Management –** 'the efficient and systematic control of the creation, receipt, maintenance, use and disposal of records, including processes for capturing and maintaining evidence of and information about business activities and transactions in the form of records' (AS ISO 15489.1-2002 Australian Standard Records Management Part 1: General).
- **Retention Period** Specified period for which a record must be kept before it may be destroyed.

Self-Check -3	Written Test

Directions: Answer all the questions listed below.

1. **Define documentation.**

Note: **Satisfactory rating – 15 points** **Unsatisfactory - below 15 points**

Score = _____

Rating: _____

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HSE, Maintaining portable and transportable electrical equipment, HSE Books, second edition 2004, http://www.hse.gov.uk/pubns/priced/hsg107.pdf

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