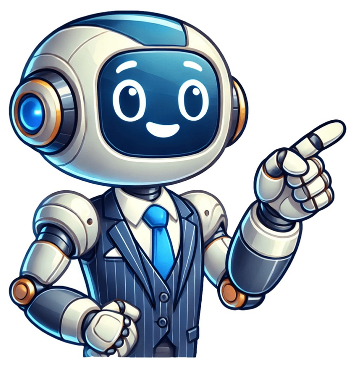

Why is it called a dumpy level

Dumpy Level: An Optical Instrument for Levelling Operations The dumpy level, also known as an automatic level or builder's level, is a crucial tool for engineers, architects, and surveyors to determine elevations and distances between points. This article delves into the world of dumpy levels, exploring their history, components, and working principle. Joining TheConstructor can provide opportunities to connect with others, ask questions, write articles, and more. If you have an account, sign in to access additional benefits. The level of any surface plays a vital role in planning, designing, and construction projects. One method for finding the ground level is by using a levelling instrument, such as the dumpy level. This article focuses on the dumpy level, an optical instrument used for carrying out levelling operations and picking points from the ground in the same horizontal plane. The dumpy level consists of a telescope tube firmly held between two collars and adjusting screws. The complete instrument is staged by a vertical spindle. By using this instrument, one can determine elevations of different points and the distance between points of the same elevation. A brief history of the dumpy level dates back to the 19th century. It was invented in 1832 by Willian Gravatt from England. The instrument has been used to check construction sites and road crossing sections over time. The telescope on the machine can be rotated along the horizontal plane, allowing for the determination of relative elevation through dumpy-level surveying. The dumpy level works on the principle of establishing a visual relationship between two or more points, using a built-in telescope and levelling bubble. The equipment consists of a telescope, tribrach, compass, vertical spindle, and tripod. The telescope measures distance between objects/points in line of sight. The tribrach's correctness is confirmed when the bubble in the levelling tube aligns itself at the centre position. The levelling head is often referred to as a trivet, which comprises two triangular-shaped plates positioned parallel to each other. Three grooves are strategically placed at the corners of these plates to support foot screws. A tripod serves as a stabilizing platform for the entire levelling instrument, featuring three adjustable legs that can be set to precise positions. The legs' uniform height allows for flexibility in deployment, while steel shoes at their base ensure stable positioning on uneven terrain. Dumpy levels are renowned for delivering high accuracy results in most Tachometric methods, boasting an impressive accuracy ratio of 1:4000 over every 100 meters. This device plays a pivotal role in surveying land by determining the relative height and distance between various locations. It also facilitates the assessment of differences in height between two points and measures the distance and height of multiple locations via the principle of relativity. The instrument's accuracy, coupled with its ease of use and adaptability to diverse ground types, makes it a preferred choice among surveyors. Moreover, adjustments can be made as needed to suit specific requirements. However, dumpy levels have some limitations, including reduced precision compared to more advanced instruments, vulnerability to atmospheric conditions and calibration errors, and difficulties in surveying steep slopes or inaccessible areas. Dumpy Level: A High-Precision Optical Instrument for Surveying and Construction The dumpy level is a crucial tool in surveying and construction, used to establish horizontal planes, measure height differences, and accurately determine elevations. Invented by William Gravatt in 1832, this instrument revolutionized surveying techniques with its fixed telescope, which improves stability and accuracy. The circular compass, situated beneath the telescope, determines the magnetic bearing of a line by setting its pointer to zero when aligned with the north direction. This enables surveyors to establish directional references. At the instrument's center lies the vertical spindle, allowing the telescope to rotate horizontally and serving as the main axis of rotation, connecting it to the tripod stand. The tribrach, a circular base plate supporting the instrument, ensures stability through levelling screws that align the dumpy level with precision, maintaining even weight distribution for accuracy. Adjustable foot screws regulate the tribrach's position by rotating to center the bubble tubes, ensuring the instrument is perfectly level. The leveling head, or trivet, consists of two parallel triangular plates providing a stable platform for precise adjustments. The tripod, with three adjustable legs and steel shoes for stability, supports the entire levelling instrument. To set up, the dumpy level is mounted on the tripod, leveled using foot screws and bubble tubes, and then used to sight a graduated leveling staff at a known reference point. Measurements are recorded for backsight, foresight, and intermediate sight to calculate height differences, determining elevation differences for surveying and construction purposes. A datum plane serves as an arbitrary position or reference point from which measurements are calculated, with the reduced level being the height or depth of a point above or below this chosen datum. Benchmarks, either fixed reference points of known height or temporary assumed elevations, are used as bases for leveling, including those established by national survey agencies like the Geodetic Triangulation Survey. The Mean Sea Level is used as a standard reference for measuring elevations, with the line of collimation being an imaginary line through the crosshairs and optical center towards the target, and the height of instrument calculated relative to the datum. BSHI=BM+BS where BM is the benchmark elevation and BS is the backsight reading. Backsight (BS) is the first reading taken on a staff positioned at a known elevation, helping to determine the height of the instrument (HI). Foresight (FS) is the last reading taken from an instrument setup, typically at an unknown elevation, used to calculate elevation changes by subtracting it from the height of the instrument. A change point (CP) is a temporary point where both foresight and backsight are taken when shifting the instrument to a new location. Intermediate Sight (IS) is a reading taken between two change points to determine the elevation of an additional point without resetting the instrument. Levelling Staff A levelling staff, also known as a rod, is a key tool used in surveying for measuring the difference in height (elevation) between two points. It works with dumpy levels or other instruments to determine Reduced Level (RL) and is typically made from lightweight materials like wood, aluminium, or fibreglass for ease of handling. The staff has measurements marked in centimetres and millimetres, divided into whole numbers and smaller divisions for precise readings. Red and White Stripes Enhance visibility with alternating red and white stripes and a bold central line for precise measurement. Accuracy Parallax requires the staff to be read without parallax error, meaning the crosshair of the instrument and staff should be in sharp focus simultaneously. Vertical Alignment ensures the staff is held perfectly vertically to avoid measurement errors. Benchmarks are fixed reference points with known elevations used for levelling and height measurements. In India, benchmarks are established by the Survey of India (SoI) and include GTS Benchmarks provided accurate elevation data referenced to Mean Sea Level (MSL). Differential levelling is a surveying technique used by the Survey of India to provide accurate elevation data, employing a dumpy level and levelling staff to measure vertical distances between points. The primary goal is to determine the Reduced Level of unknown points relative to a known benchmark. This is achieved by measuring vertical distances using a levelling instrument and staff, with terms like Height of the Instrument and Height of Collimation describing the elevation of the horizontal line of sight. To set up, position the level and ensure it's properly levelled, then take an initial backsight reading on the Benchmark to determine the Height of the Instrument. Subsequent measurements involve taking intermediate and foresight readings at various points, calculating each point's Reduced Level using the formula RL = HI – FS. When moving to new positions, shift the instrument and take a backsight reading on the change point to establish a new HI, repeating this process until the final point is reached. A sample field observation table records measurements using the Height of Collimation Method, including station, backsight, intermediate sight, foresight, Height of Instrument, Reduced Level, and remarks. The arithmetic check in the Height of Instrument Method ensures calculations are correct, with the equation ∑BS – ∑FS = RLLast Point – RLFirst Point confirming that the total rise and fall in RLs match the difference between the first and last RL. Alternatively, the Rise and Fall Method calculates the rise or fall between consecutive points to determine their elevations accurately, taking initial and subsequent measurements, determining whether each new point has risen or fallen, and calculating the Reduced Level accordingly. The leveling process involves calculating the Reduced Level (RL) by taking into account the Rise or Fall of each point. To do this, one must follow these steps: 1. Calculate the RL for each point using the previous RL plus any Rise or minus any Fall. 2. When shifting to a new position, take a Backsight (BS) reading on the Change Point (CP). 3. Repeat these steps until reaching the final point. The arithmetic check ensures accuracy by verifying that the total of BS - FS equals the difference between the last and first RL points. This confirms that the Rise and Fall Method is more accurate than the Height of Instrument (HI) Method. The design of leveling instruments differs between dumpy levels and Wye levels. A dumpy level has its telescope fixed to the spindle, whereas a Wye level's telescope is supported by two vertical clips. Although both are used in surveying, they serve distinct purposes. A dumpy level specifically measures vertical angles, whereas a theodolite can perform both horizontal and vertical measurements. Despite their differences, both instruments remain essential tools for professionals. Surveyors continue to use theodolites for various applications, including navigation and meteorology. Dumpy levels are also widely used in surveying and construction to measure height variations and set reference points. They are often referred to as surveyor's levels or builder's levels. One advantage of a tilting level over a dumpy level is its ability to take multiple readings from a single setup, reducing the need for repeated adjustments. This feature eliminates collimation errors and enhances convenience during leveling tasks. When it comes to selecting a dumpy level, options like the Leica NA730 Plus are considered top choices due to their high magnification, reliability, and durability. The term "dumpy" itself has multiple meanings, but in surveying, it refers to a specific type of leveling instrument. The accuracy of a dumpy level can be assessed through a two-peg test, which checks the instrument's ability to display true horizontal readings. Using an old dumpy level involves adjusting its height and balancing the tripod on a stable surface. Once set up, the telescope is aligned with reference points to take accurate measurements. 1. Ensure dumpy level is accurately set up with crosshairs aligned to desired points. 2. Record readings for elevation or distance calculations, noting limitations on low-light conditions and angle measurement. Dumpy levels cannot measure angles; instead, theodolites are used for this purpose. A Wye level combines spirit level and telescope in a Y-shaped setup for increased flexibility. Cooke’s reversible level offers both dumpy level and Y-level functions without rotation, reducing collimation errors. Reduced level (RL) in dumpy levels calculates actual height values by subtracting measurements from instrument height, providing ground “real” height at staff base. Dumpy level formula: Benchmark height + backsight measurement - foresight measurement. The only leveling task a dumpy level cannot perform is measuring angles accurately; theodolites or specialized instruments are required for this. Best leveling tools include Bosch Professional GLL 3-15X Line Laser with self-leveling accuracy of ±0.2 mm/m and range of 15 meters, as well as total station survey instruments, leveling staffs, measuring tapes, and laser measuring tapes. Total stations can function as theodolites due to integrated distance meter capabilities for simultaneous angle and distance measurement.