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Determination of Slope of Hilly Terrain by Using Proposed Method of Resolution of Forces

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Abstract : For any construction project, slope calculations are necessary in order to evaluate constructability on the site, such as the slope of parking lots, sidewalks, and ramps, the slope of sanitary sewer lines, slope of roads and highways. When slopes and grades are to be determined, designers are concerned with establishing proper slopes and grades for their projects to assess cut and fill volume calculations and determine inverts of pipes. There are several established instruments commonly used to determine slopes, such as Dumpy level, Abney level or Hand Level, Inclinometer, Tacheometer, Henry method, etc., and surveyors are very familiar with the use of these instruments to calculate slopes. However, they have some other drawbacks which cannot be neglected while major surveying works. Firstly, it requires expert surveyors and skilled staff. The accessibility, visibility, and accommodation to remote hilly terrain with these instruments and surveying teams are difficult. Also, determination of gentle slopes in case of road and sewer drainage constructions in congested urban places with these instruments is not easy. This paper aims to develop a method that requires minimum field work, minimum instruments, no high-end technology or instruments or software, and low cost. It requires basic and handy surveying accessories like a plane table with a fixed weighing machine, standard weights, alidade, tripod, and ranging rods should be able to determine the terrain slope in congested areas as well as in remote hilly terrain. Also, being simple and easy to understand and perform the people of that local rural area can be easily trained for the proposed method. The idea for the proposed method is based on the principle of resolution of weight components. When any object of standard weight 'W' is placed on an inclined surface with a weighing machine below it, then its cosine component of weight is presently measured by that weighing machine. The slope can be determined from the relation between the true or actual weight and the apparent weight. A proper procedure is to be followed, which includes site location, centering and sighting work, fixing the whole set at the identified station, and finally taking the readings. A set of experiments for slope determination, mild and moderate slopes, are carried out by the proposed method and by the theodolite instrument in a controlled environment, on the college campus, and uncontrolled environment actual site. The slopes determined by the proposed method were compared with those determined by the established instruments. For example, it was observed that for the same distances for mild slope, the difference in the slope obtained by the proposed method and by the established method ranges from 4' for a distance of 8m to 2o15'20" for a distance of 16m for an uncontrolled environment. Thus, for mild slopes, the proposed method is suitable for a distance of 8m to 10m. The correlation between the proposed method and the established method shows a good correlation of 0.91 to 0.99 for various combinations, mild and moderate slope, with the controlled and uncontrolled environment.

Keywords : surveying, plane table, weight component, slope determination, hilly terrain, construction
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