HORIZONTAL ANGLE MEASUREMENT

INTRODUCTION: This laboratory is designed to help the student learn measure horizontal angles using a theodolite.

EQUIPMENT REQUIRED: Theodolite, tripod, range poles, plumb bobs

JOBS: Instrument person
Rod person
Note taker
Observer

PROCEDURE: Each party will be assigned three points on the polygon. Each will set up the theodolite over the middle point; set an initial value for the backsight and measure the interior angle by repetition. Each person in the party will change the initial value for the backsight by 90 degrees for his/her measurement of the interior angle. When all members of the party have measured the angle, the angle measurements will be reduced and a resulting mean interior angle and standard deviation determined.

Each member of the party will complete the exercise before anyone in the group can leave. Those members of the party who have completed their turn are encouraged to help the others.

SETTING UP THE THEODOLITE AND MEASURING ANGLES

1. Setting up the theodolite is a fairly intricate process. You must get the optical center of the theodolite directly over the point on which you are setting up; and you must get the horizontal circle in the theodolite on a horizontal plane.

To accomplish the first of these goals, use the plumb bob supplied on the tripod. Once you have secured the theodolite to the tripod, the plastic plumb bob top will snap into the screw holding the theodolite. Now hold the tripod so that the top surface (on which the theodolite sits is about level and adjust the tripod legs so that they match the surface. Then move the tripod so that the plumb bob is over the point, and set the legs solidly into the ground. IF THE TOP SURFACE IS NOT CLOSE TO LEVEL, YOU WILL HAVE TO START AGAIN.

Once you have the plumb bob within about 1-cm of the point and the tripod surface close to level, you then level the theodolite. If the circle is not centered over the point, then loosen the screw holding the theodolite to the tripod and move the theodolite slightly until the circle in the optical plummet is centered on the point.

You are now ready for the final leveling process. There is a very sensitive bubble right underneath the telescope. Loosen the lower motion locking screw and rotate the theodolite until the sensitive bubble is parallel to two of the leveling screws. Adjust the two leveling screws until the bubble is centered. Next rotate the theodolite in 90° increments, leveling until the bubble is stationary or until you cannot improve its position. The theodolite is now ready the measure angles.
2. MEASURING ANGLES

You will be measuring angles by repetition, i.e. measuring each one several times, and then averaging. To begin you must set the horizontal circle to 0°00’00”. To accomplish this, loosen both the upper and lower motion locking screws and rotate the horizontal circle until you are close to 0°. Then set the optical micrometer on 0°00’00” and lock the upper motion locking screw. Now turn the upper motion tangent screw until the 0° mark on the horizontal circle is centered in the double cross hair. DO NOT DISTURB THE UPPER MOTION SCREWS ONCE YOU HAVE EVERYTHING TO ZERO.

The lower motion is still unlocked, so rotate the theodolite until the telescope is facing the point at the other end of one of the adjacent legs of the traverse. Lock the lower motion locking screw, and turn the lower motion tangent screw until the telescope vertical cross hair is exactly on the point you are sighting. Now unlock the upper motion locking screw and rotate the telescope until you are looking at the point at the end of the other adjacent leg. Lock the upper motion locking screw and use the upper motion tangent screw to get the vertical cross hair exactly on the point. Now use the optical micrometer to center the double cross hair on the nearest whole degree mark on the horizontal circle. You may now read and record the angle.

Having measured the angle once, the general principle should be apparent. If you unlock the lower motion, the theodolite rotates with without changing the angle reading. If you unlock the upper motion, the angle reading changes.

Thus to repeat the angle measurement, you unlock the lower motion, sight back on the original point, lock the lower motion, unlock the upper motion and turn back to the second point, read and record the angle. The new reading should be close to twice the original reading. If it differs by more than 30” from exactly twice the first reading, you must repeat the process.