Practical 10: Practical test: Using the theodolite

Requirements of the practical test

The practical test has got three parts:

1. setting up the theodolite;
2. measuring three points;
3. processing the raw measurements.

The whole test has to be done within 60 minutes, meanwhile the first part has to be fulfilled in 15 minutes at maximum.

Each student has to carry out the whole test on their own.

If a student fails the test, all the three parts has to be repeated, even in the case that some of the parts were passed.

The teacher checks:

1. after setting up the theodolite:
   a. the standing axis goes through the station point. The offset has to be less than 2 mm in any position of the alidade;
   b. verticality of the standing axis. The bubble of the bubble tube has to be on the same point within 2 mm in any position of the alidade.
2. while measuring the points:
   a. order of measurements. The correct order is to measure at first all the points from left to right in face left, then turn the instrument into face right and measure at second all the points in opposite way, so from right to left. This way the first point measured in face left will be the last one measured in face right. Thus the stability of your instrument can be checked and the effect of slight rotation both the instrument and the horizontal circle can be minimized.
   b. sighting the points. The string of the plummet has to be sighted horizontally, while its lowest point vertically.
3. after the measurements:
   a. all the necessary cells of the field-book are filled in;
   b. any sort of blunder in the field-book.
4. after the processing:
   a. all the computations. No any computational error is allowed.
   b. the trend both in the effect of collimation errors and in index errors.
   c. the computed relative mean directions are crosschecked with angles computed from the known coordinates of the station and the measured points. Typically, a maximum of 60” of deviation is allowed, which is less than a few millimetres expressed in range.
   d. the reduced level of the trunnion axis is computed using the measured zenith angles, the distances computed from the known coordinates and the reduced level of the measured points.

Pay attention to the following aspects

#	typical mistake of the practical test	how to avoid it
1.	Setting the bubble tube to the middle point instead of the normal point.	Find the normal point and the set bubble to the normal point.
2.	Setting the bubble tube only in one position of the alidade.	Set the bubble tube in two perpendicular position of the alidade, then rotate the alidade into a few arbitrary positions and check whether the bubble of the bubble tube remains in the same position
3.	Trying to set the bubble more precisely than expected and losing to much time.	±2 mm in the position of the bubble is the tolerance, deviation less than the tolerance doesn't matter.
4.	The picture of the station point and/or the cross-hairs in the optical plummet are not clear enough.	Slightly rotate the optical plummet to make the diaphragm clear and slightly push or pull the optical plummet to make the picture clear.
4.	The offset of the instrument from the station point is more than allowed.	Don't forget to shift the instrument on the header of the tripod after setting the bubble tube.
5.	Checking the offset of the instrument from the station point only in one position of the alidade.	Sometimes the optical plummet is not fully adjusted to the standing axis. In this case the center of the optical plummet draws a small circle around the standing axis while rotating the alidade around the standing axis. In this case the centre of that circle has to be on the station point. Rotate the alidade four times by 90 degree, check the position of the cross-hairs and if you realise that small circle, slide the instrument on the header of the tripod until the centre of that circle is precisely on the station point.
6.	Changing from face left to face right at each direction.	Sight all the points from left to right in face left, then turn into face right and sight all the points in opposite way. Make sure that the last point in face right is the same point as the first one in face left.
7.	Mixing up face left and face right	In face left: • the vertical circle is on the left side • reading on the vertical circle is around 90 degree, while in face right it is around 270 degree
8.	Filling the readings in a wrong cell of the book.	Write the numbers in their correct cell.
9.	Forgetting the sign of the effect of the collimation error or the index error.	Don't forget to put the sign down, even if the value is positive.
10.	Wrong sign of the effect of the collimation error or the index error is used.	Make sure that the effect of the collimation error or the index error can be treated as a correction of the reading in face left to get horizontal direction or zenith angle.
11.	Wrong mean direction is calculated.	Calculate the mean direction in two independent ways: 1. change the FR reading by 180 degrees (add or subtract depending on the magnitude) and compute the mean value of this and the original FL reading. 2. calculate the effect of the collimation error first, and add it to the original FL reading.
12.	Wrong zenith angle is computed.	Calculate zenith angle in two independent ways:

		1. calculate the effect of the collimation error first, and add it to the original FL reading 2. subtract the FR reading from the FL, then divide the result by two. Check yourself by comparing the results of the two computations! Only ±1 second difference is allowed as an effect of rounding.
13.	Negative angle is in the book.	The effect of collimation error or the index error must be around zero, their absolute value is typically less than 60 second. These angles can be negative, but all the other angles in the field-book must be positive (between 0 and 360 degrees). If the result of a computation is negative, add 360 degrees to it. This conversion is definitely needed when the zenith angle is calculated by subtracting the vertical reading in face right from the one in face left. Moreover it might be necessary for the calculation of the relative mean direction, when the mean direction of the first target is higher than the mean direction of the other target.
14.	Half seconds are in the book.	Only whole seconds are used. If the result of a computation ends with .5 second, please round it to the nearest even integer.
15.	Totally wrong horizontal angles are computed.	Don’t forget to draw a sketch of the station and the measured points and estimate the horizontal angles before any measurement. Before submitting the book, compare the measured angles to the estimated ones.