
NATR 142
Plane Surveying
Fall 2023

Second Examination Study Guide

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- Know and be able to use formulas for grade (slope) and % grade.
- Define the terms vertical line, horizontal plane, datum, mean sea level, horizontal line, and elevation.
- List and discuss the many leveling methods covered (or outlined) in class.
- List different leveling equipment and understand the differences among the dumpy, automatic, and laser levels.
- Understand the terms instrument set, BM, TBM, TP, BS, HI, FS, IS, note reductions, balancing of sights, closed circuit, closure error, and arithmetic check as well as when each is used in the development of proper leveling notes.
- Understand the steps involved in differential leveling, profile leveling, cross-section leveling, reciprocal leveling, three-wire leveling, and peg test.
- Understand when a modified version of differential leveling notes has to be followed.
- Set up proper field notes for differential, modified differential, profile, and cross-section leveling (including the two formats for field notes in cross-section leveling)
- Perform leveling note reductions, arithmetic check, and closure error for differential, modified differential, profile, and cross-section leveling.
- List some of the common mistakes that can lead to errors when performing leveling measurements.
- Describe how to plan and proceed in ground measurements for profile and cross-section leveling.
- Understand how to minimize measurement errors in leveling exercises.
- Understand the difference between transits and theodolites and the applications of each.
- List why setting up a theodolite is usually more involved than a dumpy or a laser level.
- Understand the differences between directional and repeating optical theodolites and the advantages and disadvantages of each.
- Find horizontal angles when given a list of data from a repeating theodolite.
- Calculate an angle when given the first and second readings of a directional theodolite.
- Discuss vertical angles and how these are referenced in transits and theodolites (horizontal, zenith, and nadir).
- Know and be able to use formulas for the sum of interior angles [i.e., $(n-2)*180^\circ$].
- Be able to know why, when, and how deflection angles are measured.
- Understand how to lay off angles using a theodolite and what is meant by interlining (balancing in) and its application.
- Understand when you need to and how to prolong a straight line by double centering, triangulation techniques, and right angle offset.

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Second Examination
Equations Sheet

1 ch = 100 links = 66 ft = 4 rods

1° = 60'; 1' = 60"; 1° = 3600"

1 yd = 3 ft

1 m = 3.2808 ft

1 mi = 5280 ft = 1.609 km

1 ac = 43,560 ft²

1 ft = 12 in

$$\text{Grade} = \frac{\% \text{ Grade}}{100\%} = \frac{\text{rise}}{\text{run}}$$

$$\text{Cut|Fill} = \text{Elev.}_{\text{ground}} - \text{Elev.}_{\text{grade}}$$

$$A = \text{Cut|Fill} \cdot W$$

$$V = \left(\frac{A_1 + A_2}{2} \right) \cdot L$$

$$E = 0.02 \sqrt{N}$$

$$\Sigma \Delta = (n - 2) \cdot 180^\circ$$

$$HI = \text{Elev.} + BS$$

$$\text{Elev.} = HI - FS$$