EARTHWORK ESTIMATION

PURPOSE

To learn how to estimate the amount of earthwork required for their design of alignment and typical sections.

LEARNING OBJECTIVE

Be able to estimate the amount of earthwork based on the method of average end areas.

REQUIRED RESOURCES

- Completed Design Controls and Criteria (A5_design_controls_criteria.xlsx)
- Completed alignment alternative (Activity 10)
- Completed typical section drawings (Activity 12)
- CAD drawings of Elliot Highway existing ground cross sections (Elliot_xsections.pdf)

TASKS

Work with your project group. All the design controls and criteria remain the same. Follow the procedure here to estimate earthwork quantities based on the method of average end areas:

1. For every 500 feet, on the drawings of Elliot Highway existing ground cross sections, superimpose your typical section on top of the existing ground. An example is shown in Figure 1 below. The 0 mark on the horizontal axis identifies the centerline of the existing alignment. The dashed line represents the existing ground. The gray area represents the end area of the cut required for a new alignment that has its centerline located 100 feet west of the existing centerline at elevation 1650 ft. Estimate the end area of cut and enter the area \( A_1 \) in a Excel spreadsheet for earthwork calculation. Repeat the same end area calculation for every 500 ft.

2. Once all end areas are calculated, the total cut or fill area between two 500 ft stations can be calculated in the way illustrated in Figure 2, which shows the profile view of the existing and new alignments. The total cut quantity between stations 10+00 and 15+00 is:

\[
\frac{(A_1 + A_2) \times 500}{2}
\]

where \( A_1 \) and \( A_2 \) are end areas at station 10+00 and 15+00 in square feet.
3. Repeat the process for all the 500 ft stations along the alignment.

4. Use the spreadsheet to calculate total cut and fill quantities required for your alignment design.

**Deliverable**

Completed spreadsheet table of earthwork quantity calculation.

**Information**

The earthwork calculation exercise of this activity was created to help you understand how the amount of earthwork quantity is related to the design alignment and the profile of the terrain. You can see that the earthwork amount you calculated is only a rough approximation of the actual amount. In an actual design project you will not need to perform such calculation. In practice, most of the design works are performed with CAD and supplemental geometric design software. Once you determine your horizontal and vertical alignment, the software will calculate the amount of earthwork automatically.
The activities in this Chapter are designed to provide you an opportunity to

1. Become familiar with the *Highway Safety Manual* predictive model
2. Learn to apply it to a project

The learning opportunity is facilitated with a highway design project which enables you to apply the base knowledge of the predictive model to an actual highway alignment.

The two activities provided in this chapter are designed to cover information in Chapter 3 of the *Highway Safety Manual*. You will learn to apply the HSM predictive models for highway safety.

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In **Activity 15**, you learn to segment your design alignment to be able to apply the predictive model and apply crash modification factors to calculate relative safety of your alignment.

In **Activity 16**, along the same stretch of the highway alignment, you will work with the same groups to identify where safety improvement measures are warranted and then design them into the project.