CE 353 PRINCIPLES OF TRANSPORTATION AND TRAFFIC ENGINEERING

PROJECT WORK

These hand – outs are prepared to guide you through the project work of CE 353 Principles of Transportation and Traffic Engineering course. Without attending the lecture and recitation hours these will not help you much since they are not prepared as recipe but as guide only.

INTRODUCTION

You are given digital topographic maps. The coordinates of origin and destination of the required highway to be designed are indicated on your project syllabus as A and B. Your task is to carry out a highway design to connect the points A and B considering economy, safety and rider's comfort.

The topographic maps are composed of contour lines. Contour lines are imaginary lines that connect the points of equal height. The contour interval is the difference in height between two consecutive contour lines.

The classification, design speed and the terrain type of the highway are mentioned on the maps as 'Class / Terrain Type / Design Speed'. The standards of the highway will be determined according to these.

The project work will be carried out in five steps. At the end of each step, written reports will be submitted as stated below.

HOW TO WRITE THE PROJECT REPORT

The reports that you are going to prepare should consist of the following parts:

1) Aim
2) Procedure
3) Calculations: Every calculation you carried out and every formula you used should be shown in this part. If you are using a spreadsheet, you do not need to show the details of your calculations but you should certainly state the formulas you used.
4) Discussion of Results: This is the most important part of your report. Please specify all the things you considered during your work. State the things that are particular to your project.
5) Conclusion

Every part of the report has special importance and you will lose credits for the missing parts. The table handed-out should be filled in and submitted as the first page of your report.

PROJECT WORK STEPS

STEP 1 - ZERO LINE STUDY

INTRODUCTION

Zero line study is a rough study to determine an initial possible route for horizontal alignment which does not violate the gradient limitations.

PROCEDURE

- The standards of your highway is specified on top of your map as:
  'Class / Terrain Type / Design Speed'.

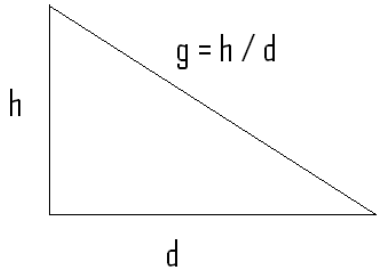
With these standards, refer to your 'Geometric Standards of Highways Table' and determine your maximum gradient (g_{max}).

- The gradients you use should satisfy;

$$g \leq g_{max}$$

- Calculate the *"divider opening"* by;

$$d = h / g$$



where; h = contour interval (m) (that's 1m in your case)
d = horizontal distance (m)
g = selected gradient (%)

CAD OPERATION;

Here "divider opening" is a term only. In CAD, you will carry out this operation by drawing circles.

By starting from point A, draw that circle as originated at A & having the radius "d". Your next center will be the intersection of this circle and *next contour level*.

- Paying attention to the restrictions stated below, start at point A and by passing to the next contour with drawing circles, end with point B.

- Locate the zero line by connecting the centers (divider markings) with broken lines. (You may use PLINE for this case)

Ex:

If selected g= 3 %, your *divider length* = circle radius = 33.333m

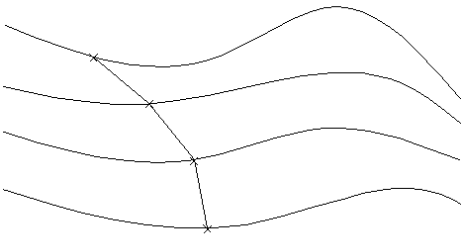
RESTRICTIONS

- You are allowed to **change the gradient at most 2 different points** on your map at most. Keep in mind that transforming from +a% to –a% gradient is a change of gradient.

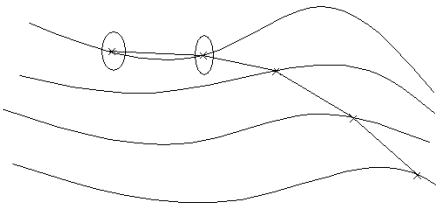
- Cross the rivers and roads perpendicularly as shown. (You may violate the divider opening restriction in this case)

- Avoid zig–zags when drawing zero lines.

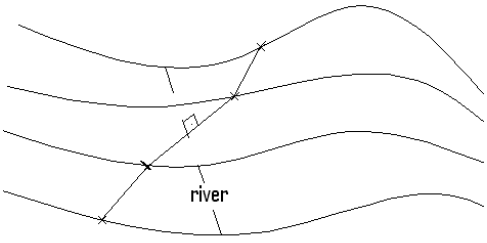
- Keep in mind that transforming from +a% to –a% gradient is a change of gradient.



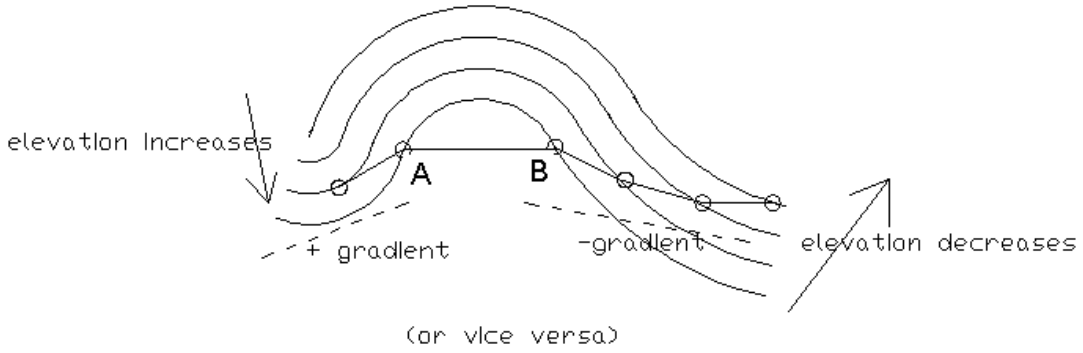
RIGHT



WRONG
(same contour)



RIVER PASSING



Note that between points A and B there is no elevation difference therefore there is no slope!!! But there are gradient changes at points A and B.

CAD RESTRICTIONS

Through your project DO NOT forget to work with layers. In first step, create layers as DIVIDERS & ZERO-LINE . Don't erase any of your work. Keep them in proper layers.

Your drawing including the map should be named as

ce353_group##(step##).dwg

Learn the group number from your project advisor. At every submission stage, give the proper step number, eg. ce353_group53(step01).dwg

DON'T use any capital letter in the file name.

Your file name should be exactly in the same format as given. Be careful about the name. Find below the names which are not accepted:

Ce353_group07(step01).dwg
ce353_group07(step01).dwg.dwg
ce353_group07(step01).dwg
ce353_group07(step1).dwg
ce353_group7(step01).dwg
ce353_gr07(step1).dwg
ce353_group07(step1)son.dwg

SUBMISSION OF STEP-1

You have to submit your CAD study, your report & a printout from your CAD.

- You have to submit your CAD file on METU-ONLINE.
- You have to submit your Report & Print-out to Asst. Murat Özen

HOW TO PLOT YOUR WORK

Your maps are 1:1 scaled digital maps.

The following steps are explained in order to plot your work on an A1 size paper with 1:2000 scale.

- Draw a rectangular frame as 841*594 units on an empty space at CAD. Don't forget to use another layer as CE353_frame for that.
- Scale it by 2.
- Offset the rectangular frame to inside with 20. (This for internal frame)
- Locate (move & rotate) your frame as to cover your starting & ending points.
- Locate a title block including your names, group number, the stage of work, etc.
- Plot your work with the scale of 1:2 at a copy-center.

In case of any hesitations on CAD OPERATIONS please contact with **Asst. Murat Özen (mozen@metu.edu.tr)** or **Instr. Cem Cüneyt Uğur (cugur@metu.edu.tr)**.

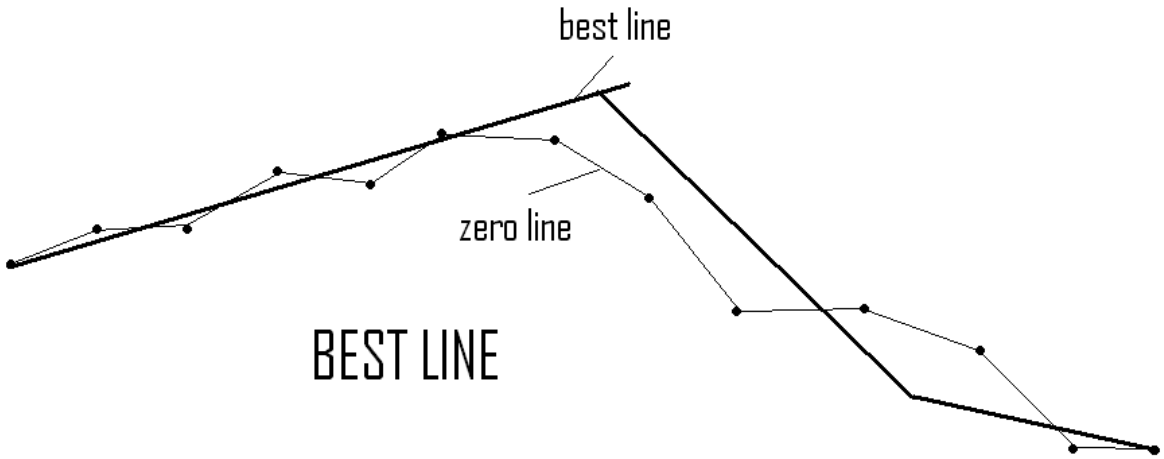
STEP 2 - ESTABLISHING BEST LINES AND HORIZONTAL CURVES

INTRODUCTION

In this study, the horizontal alignment will be finalized by establishing polygons (best lines to the zero lines) and horizontal curves.

PROCEDURE

- Draw best lines according to your zero line. Do not let these lines deviate too much from the zero line. (Less deviation --- better fit to the topography --- less cost) An example is shown below:



- Refer to your 'Geometric Standards of Highways Table' to determine your minimum radius of curvature R_{min}.

- Introduce your horizontal curves regarding your standards and restrictions listed below.

    - The radii you choose should be greater than or equal o R_{min}.
      $R_i > R_{min}$

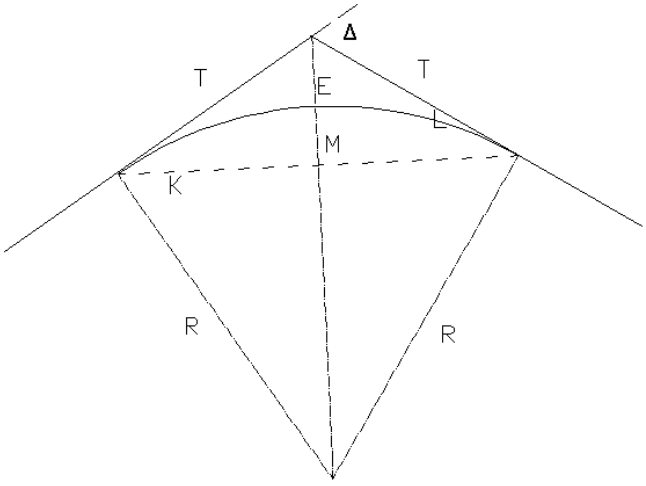
    - Minimum distance between two successive curves(d_{min}) should be;
      $d_{min} = 2*(L_{s1} + L_{s2}) / 3$
      $L_{si} = 0{,}0354\ V_d\ ^3 / R_i$
      $L_{smin} = 45$ m (if you end up with a $L_{si} < 45$ m using the above equation, forget it and use $L_{si} = 45$m instead)

where ; L_{si} = Transition distance for curve i. (m)
V_d = Design speed (km/hr)
R_i = Radius of curve i (m)

You should introduce **enough** horizontal curves.
(For further information about transition distance, please refer to lecture notes.)

- Measure your deflection angles. (Δi)

- Calculate your curve elements (T, L, M, E, K) in real distances using Δ_i and R_i. Show the curve elements for each curve on a sketch (not on your maps) as below:



- Locate your PC and PT points using calculated T values and draw your curves with the known radii and centers.

- Measure your K on your map and compare it with the calculated value.

- Do not erase zero line.