

Geography 471 (Engineering II)
Spring Term, 2005
Dr. Craig Caupp

Description

2206.471, Basic engineering techniques used in designing landforms, drainage systems, and roadways for land development projects. An overview of project development, equipment and management strategies. Spring only

Course Objectives

1. To learn fundamentals of site design (grading for level sites, drainage, and circulation). Learn to prepare and read a grading project plan in view.
2. Learn three methods of calculating the amount of soil moved for grading projects (cut & fill calculations). Learn which calculation method is appropriate for different grading projects.
3. Learn to lay out a road from points A to B. Learn how to align a road considering horizontal and vertical curves, minimum and maximum grades and cut/fill balance. Learn how to station a road alignment and prepare a plan/profile sheet.
4. Review and strengthen skills in mathematics necessary for land development calculations.
5. Learn environmental factors which influence land planning, land development and land reclamation.
6. Learn computer skills useful for analyzing and planning land modifications. (Once road alignment, calculations, and preparation of plan/profile are learned by traditional methods, computer programs will be used to automate the planing of a road alignment).

COURSE OUTLINE: (Topics)

Basic mathematic used in land development (math review Handout)

Grading

 Level sites

 Drainage ways

 Circulation

Earth works; cut and fill

Soil Erosion

Drainage consideration

Computer tools; spreadsheet, COGO, AUTOCAD, DEM, and AutoCad Land Development package

Pavement Alignment
Horizontal Curves
Vertical Curves
Alignment of road, horizontal, vertical, grading, plan/profile view
Pavement Design Considerations
Economics-Project Cost Feasibility

PROJECTS

Grading Projects
Several small projects
Large scale project (integrate drainage, level site, cut and fill calculations)
Cut and Fill Calculations
Erosion Estimation
Exercises from Handouts
Road Alignment Project, layout road meeting specifications, horizontal and vertical curves, grading, stationing, plan/profile view.

ADDITIONAL TOPICS IF TIME PERMITS

Use of GIS package in Land Development
Engineering Economics
Project Management
Stormwater Drainage
Sanitary Sewer Considerations
Use of Eagle Point Software for
Road layout, profiles, plan view
COGO
Site Design

Final Exam May 17 11:15 - 1:45.

Text

Grade Easy by Richard Untermann

Optional reference *Land Development Handbook* by Dewberry and Davis 1996. McGraw-Hill.

COURSE EXAMINATIONS:

The exams include questions from your text readings, lecture notes, and lab exercises. Types of questions include multiple choice, matching, fill-in-blank, short answer essay, and design problems.

Three exams will be given. The first exam will occur in the fifth or sixth week, the second in approximately the tenth week and the last during the scheduled final exam period. Make-up exams will be given only if the student is ill or a personal emergency occurs and the absence is reported to the instructor prior to the examination period and supported by proper written documentation.

Grades -- determined by total points accumulated:

Exam	1	100	A = 450 or more
	2	100	B = 400 to 449
Final		125	C = 350 to 399
Projects, exercises, quizzes		<u>175</u>	D = 300 to 349
			F = 299 and below
	Total	500	

Format of the of the final exam will be decided in the last month of the semester. The possible formats are, during exam period (open and closed book sections of test), one hour closed book final combined with take open notes test, during final period all open notes, or entirely take home.

Attendance Policy

Attendance will not be taken. Students assume responsibility for information and handouts missed due to absence. Lab exercises are expected to be done on time. Lab exercises missed due to absence will not be accepted.

Office GU 205 (ext. 4755) I have an open door office policy, stop by with your question at any time. Office hours: M, 2-3, 4-5, T 3-4, Wed 12:00- 1:00, F 2 - 3

Academic Dishonesty is defined to include giving or receiving aid on exams, any form of cheating, or plagiarism. Students found guilty of academic dishonesty will receive an automatic course grade of "F" and will be referred to the Campus Judicial System. For a discussion of Academic Dishonesty refer to statement in the *PATHFINDER*.

Disruption of class or any behavior in class which interferes with an effective learning environment will not be tolerated, and will result in expulsion from the classroom. Please consult the *Pathfinder*.

Assignments Geography 471 Spring 2005

(Tentative assignment list, additional handouts will be assigned for readings)

Most weekly projects are worth 10 points each, there are exceptions noted below that require more than one week to complete.

1. Slope analysis Read *Grade Easy Chapter 7. Due Feb 4*

a. Using map F as the base map

Prepare a **slope map** for map. Classify the slopes into 5% ranges. Include the line around the outside of the map and the 103 and 109 contour lines (contour lines are included for reference purposes). The slope map should be done on a **tracing paper overlay**, the slope map should include a **legend** indicating color associated with each slope range and scale.

b. Create a **cardboard model** of the terrain

c. Create a DEM in AutoCad

d. Use AutoCad Land Development software to create a slope analysis map. On a piece of tracing paper overlay, identify differences between your by hand analysis and the computer analysis. In a **short report discuss the differences you identify, include tracing paper overlay, plot of slope map from AutoCad, and answers to the following questions**. What are the differences the result of? Would any of the differences be significant enough to change your design plans?

2. Math review: Turn all work related to the problems. **Due Feb 11**

A. Grading Assignment One, Read *Grade Easy Due Feb 11*

Locate a 80 by 30 ft level pad on Maps A, B and C. On each map grade the level site by using cut, fill and cut/fill. Use a 10:1 slope ratio for the fill and a 5:1 for the cut. All work should be done on tracing paper (do not need to copy all existing contours to tracing paper, enough to locate level site). Don't draw on the base maps. **Hand in graded maps showing location and elevation of the level pads, the proposed contours and existing contours to where they meet grade. Are you able to meet grade using the 10:1 and 5:1 slopes on each map? If not which map were unable to meet grade? What slope would you have to use to meet grade? (Give slope and Map).**

3. Grading for Drainage

B. Grading Assignment B

This assignment will be worked on in class.

Work through the handout for grading for drainage on Map D.

Grade map E with swales as needed centerline of the swale at 2%, a back slope of 25%, and a side slope of a minimum of 2% and a maximum of 10%. Center line of swale at least 5 feet from house. Turn in the proposed grading plan for Map E on tracing paper. Show the location and elevation of the pad, the proposed and existing contours, spot elevations along the centerline of the swale. Would you be able to meet grade if you kept the back slope at a maximum of 10%?

Lab Feb 11 Grading for drainage assignments, hand in tracing paper overlay showing grading, drainage center line spot elevations and calculations. Due Feb 25

4. **Feb 18 Earthwork Calculations, Due Mar 4**

- C. (30 points) Grading Assignment C cut/fill calculation, earthworks, volumes
Read Grade Easy Section on Earthworks Read cut/fill handout.
Level a 90 by 40 site at location picked by instructor (use this grading for your comparison of different calculation methods. (Use 20%cut and 10% fill).
Compare the results of volume of earth moved for the grading done for the cut-fill combination for Map C using four methods of calculating earth moved: Cross section, contour method **correction for eq. 10.10** (contour plane), grid method and computer calculated. Do the methods give similar results? Which do you think is the most accurate? Turn in a copy of the grading plan for each calculation method, on the grading plan show appropriate information for each method. You need three copies of the grading plan, one copy for cross section method (showing location of baseline and locations of cross sections), one for grid method (showing location letters of grid, you might chose to have a layer for existing elevation, one for proposed, and one for difference), and one grading plan used for the contour plan method (colored cut and fill areas). Turn in all calculations. A discussion of the methods with a comparison of results. How would these calculations be done in Eagle Point and AutoCad Land Development, compare results of the by had calculations with computer calculations.

Details of assignment C

Grade the level site. The objective of this lab is to learn the three methods of calculating the amount of earth moved. For this assignment do not include any drainage swales around the level site.

Cross Section - End Section Method Required: **Map (tracing paper) showing location of base line, each cross section, and reference contours, all profiles (identified by station), digitized areas for each cross section, and table with calculations.**

Contour Plane Required: **Map (tracing paper) color coded and numbered showing no cut-fill line, each cut and fill, table of digitized area identified by cut and fill number matching map, and all calculations.**

Grid Required: **Map (tracing paper) reference contours, grid with elevations used in calculation, and all calculations.**

AutoCad **Plot of graded level site, volume calculations from each method in program.**

Report Introduction, Methods, Results, Discussion of earthwork methods and results and Conclusion, table comparing results, discussion of why differences might exist, and your opinion on which is most accurate for this problem and why?

- D. (30 points) Grading Assignment D Large Scale project **Assign Mar 4 Due Mar 18**
On the large scale map using a scale of 1:20 with CI of 1 foot
Prepare a grading plan for a 80' by 40' building, for the following specifications:
Slope of swale centerline 2%
Back slopes 20% maximum, minimum 2%
Side slopes maximum 10%, minimum 2%
10% fill
20% cut
The swale is to be located 20 feet from the edge of the slab.
You are to meet grade within the property boundary.
Turn in tracing paper showing proposed location of pad and grading plan.
Calculate the amount of earth moved. Turn in all calculations related to earthwork calculations.

Includes cross sections or contour plan or grid overlays, locations of all cross sections etc.

Test One March 11

4. Read Grade Easy section on grading for circulation, roads **Apr 1 road grading and horizontal alignment**
- E. Grading Assignment E **Due April 8**

Grade a road 40 ft. wide on map C going from the bottom of the map to the top at a 3% grade. First start at the bottom and go to the top using cuts, then start so you can use all fills, then start so you can use both cut and fills. Grade a road going from the lower left to the upper right at a 3% grade.

Read Grade Easy and handout on road alignments horizontal curve problems Alignment of Roads, handout plan/profile view **Due April 15**

Discuss Stationing, plan/profile sheet, plan view, profile, PI, Block grading, Cross sections, Coordinate system

5. vertical curve problems (Set up a spreadsheet for vertical curves) **Due April 22**
- F. **(50 points)** Large scale road project, use large map with scale of 1' : 40' **Assign April 18 Due May 9** Design road 50 feet wide from lower left hand corner to upper right hand corner. Use a design speed of 30 mph maximum with a maximum grade of 6%. Prepare a grading plan using 1:4 fill and 1:3 cut. Prepare a plan/profile sheet. The tracing paper should show the location of the centerline of the road, location of PI (station), coordinates of PI, bearings of straight line sections of road, calculations for all horizontal and vertical curves should be turned in on neatly done calculation sheet (each curve should be identified so it can be found on the plan/profile sheet). Table should be included with report including each high/low point, PI, PC and PT with station, bearings, and coordinates. The volume of earth moved by your road project will be calculated and the calculations (alone with the tracing overlay showing location of cross sections and the sheet with the cross sections). Include proposed elevations on road. 50 points project, 5 points horizontal layout, 5 points horizontal curve, 5 points stationing, 5 grading, 5 profile, 12 vertical curves, 13 cut and fill calculations. Tracing paper showing horizontal layout, calculations for each horizontal curve, plan profile sheet for section of road, calculations for each vertical curve, cross sections, earthwork calculations, 5 points summary statement on your opinion of design. The coordinates and direction of point and line in lower left, X 9930, Y 10061 at N 60° E.

(10 points) Computer aided design of road. Project F will be completed in AutoCad. Print plan profile sheet, report on comparison of methods. Table comparing by hand values with computer calculated values. Table containing stations from computer.

Test Two April 22

Use of computer program for road design (Eagle Point and/or AutoCad Land Development) Design done for assignment F will be completed in one or more computer applications, a report will be handed in comparing the results of the by hand calculations and computer generated design.

The following topics will be covered as time permits

- Use of a site design program for estimating grading changes.
- Grading done within the computer programs.
- Use of a COGO program

Handout for universal soil loss equation
Universal soil loss exercise.

Final Will be comprehensive May 17 11:15 - 1:45