MinE 483 Mine Design – Exploration Mapping
Fall 2014
(2 credit hours)

Instructors:

Instructor	Phone	Email
Keith Heasley	293-3842	Keith.Heasley@mail.wvu.edu

Lecture & Laboratory Hours: Wednesday, 4:00 – 6:30 pm, MRB Room 231

Prerequisites: MinE 261, MinE 306, Math 261, MAE 242 - MinE 411 as Concurrent

Required Textbook: None

References:

1. AutoCAD and SurvCADD Tutorials and user support manuals
2. Hartman, H.L., 1992, *SME Mining Engineering Handbook*, Sr. Ed., Vols. 1 and 2, SME, Littleton, CO, 2260 pp.
3. Wood, Gordon H., Kehn, Thomas M., Carter, M. Devereux and Culbertson, William C., 1983, *Coal Resource Classification System of the U. S. Geological Survey*, Geological Survey Circular 891, 65 pp.
4. *A Guide for Reporting Exploration Information, Resources, and Reserves*, 1992, Report of Working Party #79, Society for Mining, Metallurgy, and Exploration, Inc., 10 pp.
5. Peters, Douglas C. ed, 1991, *Geology in Coal Resource Utilization*, TechBooks, Fairfax, VA, 581 pp.

Course Description:

A mineral or coal deposit is selected by the student and instructor for the capstone mine design project. Geologic, demographic, quality and market data are integrated with computer mapping software into a comprehensive map set and exploration report.

Objectives:

1) Choose a specific mineral or coal deposit for a potential mine site, for which data is available.

2) Gather a set of basic geologic, structural and quality data such as drillhole records, laboratory reports, published reports, surface maps and market data, etc. for the deposit.

3) Organize the data using computer aided drawing, geologic modeling and mine planning software. Each significant parameter will be displayed on a separate map. A common template

for the map boundary, title block, coordinate grid, legend and project boundary will be used.

4) Present this information in the form of an exploration report including introduction, a set of drawings and maps, recommendations for additional exploration, a written summary of the demographic and geologic work, an in-place resource estimate and a database summary. Both a draft and final report are required.

Computer Applications

The students will apply software packages on word processing, graphics, spreadsheets, statistics, or SurvCADD or other commercial mine planning tools as appropriate to their project and maintained in the mine design computer laboratory.

Course Learning Activities Related to the Mining Program Outcomes (statements of observable student actions that serve as evidence of the knowledge, skills & attitudes acquired in a course and their relationship to the mining program outcomes referenced by number)

-find and use current reference sources including former employers, associates and industry people to locate geologic and quality data and information on mining conditions. (2, 5, 10, 13) This is demonstrated by the selection and application of such data to the map and layout elements. Understanding the cost constrains of getting more data until the economics justify it.

-assess the suitability and completeness of geologic and geographic information for project needs. (2, 3, 5) This is shown by the Resource Classification map and written assessment of geo-spatial relationships of the data.

-gather relevant mining information from adjacent or related mines. (2, 5, 13) The students assess what data is needed and find sources, including field trips, to satisfy required reporting.

-demonstrate familiarity with normal and abnormal values of geologic and mining variables as the data base is built, check and test results by using contour or isopach maps. (2, 10, 11) Isopach maps are drafted, critiqued, anomalies resolved or explained before maps are finalized.

-apply appropriate engineering principles to the choice of information presented and color schemes used to display quality and physical parameters of the reserve data and potential mining location. (3, 5, 11)

-use market data in the selection of quality parameter ranges. (8, 10, 12) Demographic and societal impacts of mining are anticipated, discussed in the text and influence the range of data included in the report and on the mapping.

-demonstrate teamwork, if applicable, by self-managing the project work flow and assignments. (2, 4, 5, 6) This outcome is evidenced by the degree of sharing of the tasks and demonstrated learning of each of the participants.

-model the resource geology and quality using the geologic mapping software, SURVCADD. (2, 4, 5, 7, 11) This demonstrates an ability to control the geologic modeling environment to communicate visually to a wide range of readers. Class learns and works together.

-produce a complete set of maps and write an Exploration Report Summary. (3, 7, 11)

-make an oral presentation (optional but encouraged for the MinE 483 class). (7)

Mining Engineering Component

The student is required to prepare a set of geologic, demographic and quality maps and accompanying report for the future development and mining of a mineral or coal property. The course may be completed as an individual or as a team of 2 or 3 students. Teams will stay the same in MinE484. The project consists of three principal elements:

a) Data Base - Select the general area for the project, at the discretion of the student with instructor approval. Students are encouraged to do a project in which they have an interest or experience (approval from owner of non-public data may be needed also). Collect appropriate data and create a clean database and grid files of geologic and quality information on the deposit. Plot draft contour maps. Obtain basic topographic maps and demographic data of the area.

b) Maps - Determine the project boundary; draft a title block, standard map border and coordinate grid lines as a map template. Research which parameters are important for the particular product to be mined from the deposit and determine what data ranges should be displayed on the contour iso-color maps. Create a detailed set of contour maps and drawings based on the data in (a). The title block and legend should be descriptive enough so that a reader can locate the deposit area and unambiguously identify the type of data displayed and the computer program settings used to display it.

c) Resource Report - Use the gridded data to calculate the in-place resource quantity and quality parameters for the area. Plot two cross-sections and typical drill logs. Write a draft and final report summarizing the work done over the semester including the source of the data, assumptions, location and transportation maps, geologic and quality maps and resource summary and calculation methods. Discuss whether the sample data spacing is close enough to properly evaluate the resource. Include a listing of the drill hole data file spreadsheet. This report will be a stand alone exploration report submitted in a binder with at least one page size map to orient the reader in the executive summary and large folded maps in pockets.

Typical Map Listing

The following lists a minimum of 13 required (for a coal project) maps, logs and sections in **bold type**. Additional maps may be needed depending on customer requirements, available data and the type of deposit. Non-coal project maps will be assigned on an individual basis. This data and map library forms the basis for the next course, MinE 484 Mine Design – Report.

All maps should include a line border, 3/4" inside the paper edge, title block, legend, scale bar, project boundary, coordinate lines and North arrow. Map Name and title block will be visible when the map is folded. Font and text size must be legible at the map scale printed.

1. **Regional Transportation** - showing major city, state lines, interstate highways, rail or barge routes serving the project.
2. **Mine Location** – show the project boundary on a USGS topographic base map with planographics and major surface elevation contours or similar base map. Oil and gas

wells, public water supplies, population centers, railroads, major roads, power lines, pipelines and rivers should be identified. A state line inset map helps to locate the project.

3. **Drill or core hole posting**, all sample data points are identified by symbol and name, and posted at their proper locations (may be combined with other maps) with general mine area features that are shown on all mine maps to easily orient the reader.
4. **Overburden depth** or thickness calculated from a land surface elevation Digital Terrain Model (DTM) or Topographic vector maps and the bottom of seam elevation grid.
5. **Structure**, bottom and/or top of seam elevation for bedded deposits, ore body vertical and horizontal extent for replacement and vein deposits. Faulting, folding, washouts, intrusions, horizontal stress directions and outcrops or subcrops may be included on this map or individual maps. Other mine works are often included on this map as well as other maps.
6. **Seam thickness** or ore body dimensions in plan view (other views may be needed in a structurally complex deposit).
7. **Quality parameters** such as the following for a coal property (**Ash, Sulfur, Btu**, Yield, SO_2/mmBtu, Moisture, Reflectance, methane content, etc.) presented on a consistent basis.
8. One or two annotated **Geologic Columns** or bore hole stratigraphic (strip) logs of the seam and immediate roof and floor chosen in typical and non-typical areas. (a coal project may show 10± feet below and 50± feet above the seam.) Note the vertical and horizontal scales. Typical scale is 1"=10' vertical scale with the column at least 1" wide.
9. Two **Cross Sections** (or fence diagrams) through the reserve area showing the seam or ore body, roof and floor material (back and foot wall) and major strata groups from the bottom of the hole to the surface. North-South and East-West sections are often used. Many more sections may be needed for an irregular or non-bedded deposit. Larger vertical scale cross sections (e.g. 1"=5" or 50v = 1000'h) showing only the immediate roof and floor may be needed for the ground control section of the MinE 484 report. Surface projects may need regularly spaced sections.
10. **Resource Classification** – Since sample spacing is a measure of geologic and quality spatial uncertainty, a map showing the USGS Circular 891, Coal Resource Classification System Measured, Indicated and Inferred spacing will be prepared. Sample spacing for the drill holes with seam thickness data will be used and, if quality data is not available in the same holes, sample spacing for one of the quality variables will be shown on another map. The results of these maps will be interpreted in the text.
11. At least one **page size** (8.5" x 11" to 11" x 17" paper) map to orient the reader to the project and **one or more full size maps** must be included in the report. This map or maps will be selected by the student for significance to the project and the part of the report in which it is used. Typically one map is included with the Executive Summary. Page size maps, up to 11"x17" fold out maps, may be bound into the report text which aids the reader with limited space to unfold large maps.

Description of Methods Used to Review Graphics Assignments

Faculty will be responsible for course instruction as well as for grading individual mapping assignments. Faculty will be responsible for grading the final mapping reports. The extra credit oral presentation is not graded.

Criteria for Evaluation of the Mapping Assignments and Overall Course Grades

The course grade is based upon a percentage of the cumulative points earned throughout the course.

A = 90-100
B = 80-89.9
C = 70-79.9
D = 60-69.9
F = <60

The grade will be based on the maps and report, which are prepared and will reflect a) the student's ability to seek out and utilize all available information, b) the student's logic and clarity of presentation, and c) the completeness and accuracy of the exploration information reflected by the maps and drawings and brief report.

General Information

The course is representative of a typical mining engineering project to physically characterize a mineral or coal resource. It is important to emphasize the most significant aspects of the project by devoting more space to them in the report. Sources of information may include geological reports or maps from individual states and USGS, USBM/NIOSH publications, technical papers, and articles in trade journals. Many of these sources are available on the Internet.

The location and mineral or coal project will be selected in consultation with the faculty. This report "graphic library" and database will be used as the basis for the subsequent Mine Design – Report course (MinE 484) in which a preliminary feasibility study for the proposed mine is prepared.

The project is presumed based on special information available to the student engineer but not necessarily available to the person to whom the report is directed or whose responsibility it will be to use the maps and data. It is therefore important that brief factual information is given in the report text, the maps are annotated consistently and it is written in a clear concise manner.

Computer laboratory sessions will be used to illustrate the process of data analysis, graphics, isopach generation and computation required to generate representative maps, drawings and resource report.

Class Policies

Attendance – Class meets once or twice per week and attendance is required. When meetings with special topics speakers or tours are scheduled, students are expected to attend and are responsible for the information discussed whether they attend or not. Class conflicts will be resolved at the first class meeting by rescheduling regular class to accommodate ALL enrolled students.

Students are required to maintain their MIX Email account for class communications. At times written notices will be posted in the Mine Design room MRB 231 and the Mining Department Office.

WVU recognizes the diversity of its students, many of whom must be absent from class to participate in religious observances. Students must notify their instructors by the end of the third class meeting regarding religious observances that will affect their attendance. Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of religious observance.

Teams - The instructors initially approve teams. Team members are expected to share the work assignments equally over the semester and collaborate on learning how to use the mapping and geologic modeling software. Teams may be modified or dissolved if lack of teamwork is demonstrated. One grade is given for the team unless, in unusual circumstances due to lack of participation by one team member, different grades are warranted.

Class Room - The Mine Design room is a graphics computer laboratory housing multiple computer workstations, digitizer, printers and large format color plotter, work areas and project storage. The room is kept locked at all times. Key privileges are as follows:

> All students registered in Mining Engineering may use their student ID card to enter the MRB 231 during normal office hours from 6 AM to 6 PM. Upper class students and grad students are given evening and weekend privileges. Your PIN number (last 4 # of your Student ID #) is required to open the lock after normal hours. Do NOT leave the door open when out of the room for any reason. Computers will require an ID (same as MIX) and a PIN (same as the door) to log in and use the server hard drive space allocated to each student.

Class Time - Class time is scheduled to meet regularly with your instructors. On rare occasions lectures will be conducted to make up deficiencies as required for students to complete the Final Report. The student is expected to use this time to discuss any problems or request help locating resources. The Mine Design Project success depends on your initiative. Each assignment will be reviewed in the week prior to the due date. Additional class time may be arranged as needed.

Assignments - Assignments are due on the class day scheduled during the week the assignment is due. Faculty will return mapping assignments with comments within the following two weeks. Students have the option of revising the assignment for regrading if returned within by the regarding deadline. All copies of drafts with comments on them must be submitted with any revision. Assignments turned in up to one week late (not revisions to on time homework) will

receive up to 75% of the normal points. Assignments may not be revised for improved grade if turned in late. If the final report is not completed, the student cannot pass the course.

Plagiarism - There will be no excuses for plagiarism on material presented in the mapping or written assignments. Short quotes from reference material are acceptable if the source is noted. Only a project team member may write the material included.

Writing Assignments - All writing assignments will be submitted typed on clean white 8.5" x 11" paper with exhibits and maps larger than 11" x 17" attached in clear pocket folders (or electronically). It is recommended that you keep the assignments in a three ring binder for ease of organization and updating pages (or on multiple thumb drives for back-up). Style, font, text size, arrangement, map numbering, etc. are all choices you must make for best understanding of your expected audience. Several examples of similar reports are available in the Mine Design Room. Neatness and understandable organization are important.

Oral Presentation (optional) – students will have the opportunity to prepare and present their projects orally at the end of the semester for extra credit. The presentation should last approximately 10-15 minutes plus time for questions, is intended as a way of giving you the experience of concisely presenting your work in a formal setting in front of peers and Professors. Teams will divide the presentation into approximately even time periods for each member to present a portion of the report. You are expected to use your maps as visual aids during the presentation. Use of one of the electronic presentation software packages like MS PowerPoint or Lotus Freelance Graphics capable of running on a laptop PC is suggested. This presentation will be scheduled during normal class time if possible, with the objective that all students may participate together. Expect questions from the audience. It is recommended that the team members rehearse their complete presentation with the equipment they will use before the scheduled day.

Final Report - Two copies of the final report are required by the end of the term. One will be in electronic format contained on a permanent CD-ROM; the other in written form arranged neatly in a hard-sided three ring binder. Special arrangements may be necessary for reporting proprietary data. You should keep a copy of the report for your records and for use in job interviews as evidence of your work. Any files stored on the hard drives of lab computers should be deleted after all revisions are completed and the report is saved to CD-ROM. A letter of transmittal, title page, table of contents and lists of tables and drawings are required in the finished report. References may be cited on individual pages or summarized in the back of the report.

Fundamentals of Engineering Examination – All mining engineering students are encouraged to take the FE examination as soon as they have completed the core engineering courses (typically at the end of the junior year or first semester of the senior year).

Social Justice Statement

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect and inclusion.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700).