MinE 484 (W) Mine Design – Report
Fall 2006
(4 credit hours)

Lecture & Laboratory Hours: Monday, Wednesday and Friday 1:00 - 1:50 pm;

Location: MRB Room 231

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<tr>
<th>Instructor</th>
<th>Phone</th>
<th>Email</th>
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<td>Keith Heasley</td>
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Prerequisites: MinE 411, MinE 483

Required Textbook: None

References
3. Technical journals
4. Manufacturers’ catalogs
5. Handout materials provided by instructor

Course Description
Capstone mine design project report and presentation based on the mineral or coal reserve characterized in MinE 483. Includes an integrated mine plan, schedule, equipment selection, processing plant, mine services, product description, socio-economic impacts, environmental issues and engineering economics.

Objectives
The objectives of this course are to integrate the engineering concepts and design procedures studied in other courses into a comprehensive mine plan based on the geologic, quality, and demographic features of the coal or mineral resource area mapped during the previous semester. Socio-economic and environmental issues will be addressed. At least one field trip to a mining facility is required. This feasibility study will be reported in both a written form and an oral presentation. The report will include all significant engineering tasks required to demonstrate the technical and economic features of the project. Written sections of the report will be completed in stages throughout the course. Communication of the final mining engineering feasibility study results and assumptions is critical to an appropriate management decision. A formal oral presentation of the student’s work will be held at the end of the semester.
Computer Applications

The students will apply software such as word processing, graphics, spreadsheets, statistics, ground control, ventilation and SurvCADD or other commercial mine planning tools as appropriate to their project.

Course Goals

1. Find and use current reference sources.
2. Compose written report(s) based on literature searches, vendor data, engineering calculations and assumptions. Revise written work as suggested by faculty and staff.
3. Assess the suitability of environmental, geologic and geographic information for project needs.
4. Gather relevant mining and community information from related mines and mining conditions.
5. Demonstrate familiarity with normal and abnormal values of geologic and mining variables and reference sources relating to the significance of these values. Relate permitting constraints to the project and how socio-economic issues will be accommodated.
6. Apply appropriate engineering principles to the selection of equipment and facilities needed for the mining and processing of coal or ore.
7. Evaluate, select, and recommend in writing a mining method consistent with the coal or mineral resource.
8. Provide written feedback to peers and provide self-critiques of draft report sections.
9. Assess general mineral or coal market specifications and prices for the final product(s).
10. Estimate the costs and revenues for the proposed mine plan and complete an economic analysis of the project. Explain the significance of several economic merit and value measurements to the project success.
11. Summarize in writing all findings and recommendations resulting from the feasibility study.
12. Concisely report the significant findings in a written executive summary.

Mining Engineering Component

The student is required to prepare a preliminary mine design and report for the development and mining of a mineral or coal property. The project consists of two principal elements: a) work plans and progress reports in the form of sections for the feasibility study (weeks 1-13) and b) final written report with tables, charts, maps and drawings organized in a logical way and presentation (weeks 14-16).

The course is representative of a typical mining engineering project, calling for a complete mining plan that may include geology, reserve analysis, production schedule, equipment selection, development and extraction sequence, ground control, ventilation, blasting, haulage, support facilities, power distribution, water handling, health and safety considerations,
community relations, environmental control and permitting, cost analysis, personnel training and numbers, processing plant, refuse or tailings disposal, transportation, and marketing. It is important to emphasize the most significant aspects of the project by devoting more space to them in the report.

The student must have completed MinE 483, Mine Design – Exploration Report in which the project was selected with the consent of the faculty. A set of location, geologic, quality and geographic maps and summary resource report were completed at that time. The written sections from MinE 483 will be incorporated into the final report. This course, MinE 484, Mine Design - Report uses the exploration report as a starting point to begin the mine design and report writing process. The mine plan is based on this graphic library and database. It is developed using specialized mining software and the information and principles established in the basic mining and related courses taken previously.

The project is presumed to be 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 analyze and evaluate the proposals. It is therefore important that all applicable information and assumptions are given in the report and it is written in a clear, concise manner. Remember this mine plan is an evaluation tool to be used by others. Preliminary feasibility studies are a starting point normally used for decision-making. Much more engineering and financial work is needed to build the mine.

Writing Component and Schedule of Writing Activities

Students will complete five related writing assignments of multiple sections and one oral presentation over the course of the semester. The course may be completed as an individual or team (2-3 people). Three of the writing assignments will be individual papers, while two will be the draft and final report of the group project. An approximate breakdown of each assignment is described below. A minimum of 35-50 pages of written material is required over the semester. The writing assignments are not in the order of the report because the draft of Paper #3 was prepared in MinE 483 and is not needed until the mine plan is completed.

**Paper #1.** (Weeks 1 - 5 of the semester) Mine plan, Ground Control, Ventilation, Mine Services, Equipment Selection, Development and Production Schedule sections. Students will work individually to write at least two sections totaling 6-10 pages. These papers will require a draft for instructor feedback on content, completeness and consistency.

**Paper #2.** (Weeks 6-11 Processing Plant, Permitting, Refuse or Tailings Disposal, Post Mining Land Use, Workforce, Market, Operating and Capital Cost and Economic Analysis sections. Students will work individually to write at least two sections totaling 6-10 pages. These papers will require a draft for instructor feedback on content, completeness and consistency.

**Paper #3.** (Week 12) Introduction, Location, Geology, Reserves and Quality and Summary sections. Students will revise and adapt the exploration report from the coal or mineral resource area mapped in MinE 483 for the feasibility study. Each student who acted as primary author for
a section previously will edit a different section and adapt it for the final report incorporating any new knowledge gained during the mine design process. A draft of the Conclusions and Recommendations and Executive Summary sections is required.

**Paper #4.** (Week 14) The entire report will be corrected, deficiencies identified addressed, assembled in a consistent style and submitted as a second draft for instructor feedback on organization, style, grammar and spelling. Exhibits and maps should be in final form. Each student will have an opportunity to peer review a draft section(s) of other students’ similar written work during the 12th week. It is important that the report sections written by different students be integrated together and written in a single “voice” for clarity and readability. Consistent organization, style, grammar and spelling are essential characteristics of a well presented report.

**Paper #5.** (Weeks 14-15) Final report including References and Appendices. Students will correct previous deficiencies and make sure each section is written in a consistent style, content and organization. A letter of transmittal and table of contents are required. This paper is the revision of the draft report submitted in assignment #4. A student (team) may request feedback and resubmit for an improved grade at the option of the faculty and the time remaining in the semester.

**Oral Presentation.** (Week 15) Students will create a visual and oral presentation of their mine plan and preliminary feasibility study to the class, instructors and guests. The presentation will cover the significant aspects of their work for the semester. Time for presentation is expected to take no more than 30 minutes plus questions. It is STRONGLY recommended that students practice their presentation with the same methods they plan to use in the final.

**Indication of How Writing is Related to Objectives**

The writing component for this class is directly related to the objectives of this course since communicating the results of an engineering feasibility study is critical to the success of the engineer and enterprise. The purposes of the writing assignments are to provide students with experience in: (1) selecting and critically summarizing relevant information from the mining, geologic and geographic literature, (2) detailing engineering assumptions and recommendations in written form, (3) self and peer evaluation of similar project reports, and (4) integrating basic mining and geological science concepts with applied economic analysis through written reports and an executive summary.

**Description of Methods Used to Review Writing Assignments**

This course has primary faculty, guests and teaching assistants. Faculty and Teaching Assistants will be responsible for course instruction as well as for grading individual writing assignments. Faculty will be responsible for grading second draft papers as well as the final reports.
Criteria for Evaluation of the Written Assignments and Overall Course Grades

The course grade is based upon a percentage of the cumulative points earned throughout the course. Fifty percentage points are from the engineering component and fifty percentage points are from the writing component. Letter grades are assigned as follows.

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

Specific components and their percentage of the final grade are:

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<tr>
<th>Week</th>
<th>Description</th>
<th>(Writing)</th>
<th>(Engineering)</th>
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<tr>
<td>1</td>
<td>Orientation, scope and sources of data</td>
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<tr>
<td>2-5</td>
<td>Sections 5-11, Mine plan, Equipment, Ground Control, Ventilation and Services</td>
<td>10</td>
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<tr>
<td>5</td>
<td>Writing Assignment #1, content, completeness, consistency, spelling, grammar</td>
<td>5</td>
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<tr>
<td>4-7</td>
<td>Sections 5, 12-21, Plant, Permitting, Refuse, Personnel, Market, Costs, Economics</td>
<td>15</td>
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<td></td>
<td>Writing Assignment #2, content, completeness, consistency, spelling, grammar</td>
<td>10</td>
<td></td>
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<tr>
<td>8-11</td>
<td>Sections 1-4, 22, 27 Introduction, Geology, Reserves, Location, Summary</td>
<td>5</td>
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<tr>
<td>11</td>
<td>Writing Assignment #3, content, completeness, consistency, spelling, grammar</td>
<td>5</td>
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<td>12-13</td>
<td>Writing Assignment #4, 2nd draft report, organization/style, spelling, grammar</td>
<td>10</td>
<td>5</td>
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<td>14-15</td>
<td>Writing Assignment #5, Final Report, References, and Appendices</td>
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<td>10</td>
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<td>15</td>
<td>Oral presentation, assignment #6</td>
<td>10</td>
<td>5</td>
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<td></td>
<td>Total Percentage</td>
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The descriptors of evaluation criteria for the mining engineering design assignments are as follows:

The Mining Engineering assignments will be graded on a numerical scale on the basis of a) the student’s ability to seek out and utilize available information, b) the statement and use of reasonable assumptions where data is not complete, c) the student’s logic and engineering ability used in the design, d) the completeness and accuracy of the mine design and planning reflected by the drawings and written report.

The grade earned for a given engineering assignment will be converted to a percentage of the final grade as shown in the table above. All six engineering assignments will be summarized to equal 50% of the total course grade.

Typical Report Subjects (to be used as a check list for the individual project, presented in the order suggested for the Report)

1. Introduction - Often a short statement of project purpose and general information that will orient the reader is needed to avoid confusion. This section may include some mining history of the area and the work done prior to this report. The fact that this is a student Senior Mine Design Project and the source of the data could be explained here.
2. **Location** - A description of the area geography with reference to significant local features such as access highways, towns or cities, population skills, services, rivers or streams, public structures over the reserve area, pipelines, topography, land use, and transportation network. This section also includes information on the community and socio-economic issues that may have a bearing on the ability of the company to permit the project.

3. **Geology** - Description of the mineral deposit or coal seam and the geologic features that will have an impact on the mine plan. This section will have several maps developed in MinE 483. Geology includes the physical environment of the mine, the name, geologic position and description of related strata, mineralogy and/or petrology, known and suspected faulting or structural challenges in the deposit, water, stress conditions, ground temperature, oil and gas wells, seam gases and other nearby mine workings or experience.

4. **Reserves and Quality** - The orebody, coal seam or reserve should be analyzed in detail for quantity and quality. The report should make clear whether drilling or sample points are on a close enough spacing to properly evaluate the reserve. The USGS parameters of measured, indicated or inferred status of the quantity of reserves and resources may be used. The methods of calculation and assumptions used should be clearly stated. Reserve quality information is frequently best conveyed by mapping and a written summary. The basis for the analysis such as "Dry, main bench only - 1.60 specific gravity float" must be given. Adverse coal or mineral ownership should be noted on the reserve maps. All maps and plans should have complete legends. Quality is generally reported as field average for the project area. More detail will be needed in the mine timing report in the mine plan section.

5. **Mine plan** - This section is dependant on the mining horizon selected which is a function of the mining method, equipment and geologic conditions. Explain the reasoning for the location of access openings such as shafts, slopes, adits, benches or box cuts. Where is the transportations system located? Describe the general layout of the mine, reasons for selecting the mining method, detailed extraction plan with drawings for clarification and mine timing. Timing of mine production is reported on a map by time period and with data tables and graphs of productivity, production and quality parameters. The initial development time schedule to full production output is critical to the economics of the project. How does the total recovered mineral or coal compare to the in-place reserves calculated previously?
   a. For a surface mine, how is the initial spoil handled? What is the pit sequence? Design the blasting pattern and round design. Other issues to consider may be, rehandle, backstacking, range diagrams, valley fill design, reclamation, trucking, communications, social impacts, cast blasting and vibration monitoring, etc. Have you considered post mining land use?
   b. For an underground mine, how do ground control, ventilation, and equipment characteristics affect the mine layout? Other issues to consider are high extraction mining subsidence, gas & oil wells, water wells and public water supplies, community impacts, fan noise, mining entry orientation, equipment productivity, availability and compatibility, communication and alarm systems, etc.
6. **Ground Control** - Pillar design, roof bolting, supplementary support, panel layout for retreat mining, surface subsidence, hydrologic balance, pit stability, maximum slope for contour mining, highwall safety are all issues that may need to be addressed depending on the project. Discussion of ground control experience of other mining operations near the project may be important to understanding the state of the art.

7. **Ventilation** - For underground and other potentially hazardous areas like silos and reclaim tunnels, a ventilation plan is needed before mining is allowed. A network analysis for first year of full production, normal and worst case conditions for fan selection should be presented and interpreted. A ventilation analysis should be performed which includes the number of fresh air splits, quantity of air in each split and dilution of methane, carbon dioxide, carbon monoxide or other explosive or noxious gases or dusts. Will methane drainage be required? If diesel equipment is used, how will safe working conditions be maintained and Diesel Particular Matter minimized.

8. **Equipment Selection** - A schedule of the number and kind of major mining equipment put in service each year should be reported with a justification for the selection. This equipment should match the mine plan, capital costs reported and replacement life reported in other sections. This section should include basic data on the performance of equipment used in the Mine Plan section to estimate mine capacity.

9. **Haulage and Hoisting** - What method of moving people, supplies, equipment and rock or coal will be used? Show capacity calculations to support the sizes and horsepower selected.

10. **Electric Power** - What electrical utilities are necessary and how is service brought to the mine? What is the maximum anticipated electrical power demand (size substation needed) and energy used (kW)? Develop an annotated one-line diagram of the electric distribution system at one point in time. Calculate the electrical power needs of the mine for the worst-case situation.

11. **Water Control** - Mine Drainage water pumping, process water supply and mine water distribution system descriptions are needed for production, processing, bathhouse, haulage and firefighting. Will mining change the hydrologic balance or affect water wells and ground water? If so include this in your recommendations for future work.

12. **Processing Plant** - A good description of the coal or ore processing facility should be presented. Factors such as capacity or tons per hour throughput, availability and hours of operation should be provided. A processing facility layout drawing and balanced flow sheet should be prepared. Typical equipment sizes should be indicated. Raw and clean material handling, storage and loadout facilities shown on the layout. Many design assumptions are often needed for the processing operation because of insufficient data at this stage of the design. All assumptions and logic should be discussed.

13. **Refuse or Tailings Disposal** - Coarse and fine waste material produced during mining must be disposed of in a fill area, an impoundment or injected back underground. Any dam
structure design will require slope stability, erosion and sedimentation control, which is beyond the scope of a pre-feasibility study. Calculate the refuse material volume needed and show the disposal area(s) footprint in the surface facilities layout drawing. Include the cost of this disposal method in the capital and operating costs.

14. **Surface Facilities** - Other facilities such as maintenance, explosive storage, administration, shower/change rooms, etc. are probably required. A plan view of these facilities on a topographic base map is important for the reader to understand your plan and for your use later to schedule construction and estimate capital spending. This layout may be added to the mine projections to help in planning the mine.

15. **Permitting** - A brief discussion of the permits required to start a new mine and the time and cost of obtaining them is expected. This is typically a year for a relatively simple mining project in a non-sensitive area of the Appalachians to as much as three to five years for a large western surface mine requiring an Environmental Impact Statement (EIS). Reclamation activities are ongoing for refuse areas and surface mining and will continue to occur after the mine closes. Subsidence mitigation occurs during high-extraction underground mining. A discussion of the final reclamation activity at mine closing is necessary and may result in a major cost in the economics. Environmental considerations are important to the community in which any mine is located and must be addressed.

16. **Project Schedule** - The project schedule is best depicted graphically as a bar chart or Gant chart. This is a straightforward way to show in one place the critical path for development of the project from initial engineering and permitting to construction and development through full production.

17. **Marketing** - The mine product must be sold to make an economic project. Knowledge of the market demand and likely sales price for this product(s) is critical to the success of the mine and decisions about mining horizon, cut off grade, processing method and shipping mode. State what sales price you will use and why you chose it.

18. **Personnel Requirements** - The required workforce should be analyzed by job description or classification and pay rates. This includes the supervisory force. What is the hiring schedule for personnel assigned to the project? How will personnel training be accomplished? Is a safety program important and if so how will it be administered? What benefits will be paid?

19. **Operating Cost** - An operating cost spreadsheet listed and totaled by year and item is required. Frequently separate cost accounting is made for the mining and processing activities, which are then summarized. The basis of each cost input should be explained.

20. **Capital Cost** - A capital cost spreadsheet(s) listed by year and item is required. It can include the following items (1) Capital item name or category, (2) Number of units, (3) Cost per unit, (4) Month or year required, (5) Depreciation life (tax and replacement life), (6) Expenditure by year.
21. **Economics** - Operating and capital costs are combined in the Cash Flow tables and analyzed against the project income. Income taxes are calculated on taxable income. Rates of return (Internal Rate of Return), net present value, payback period and other economic measures are determined. All assumptions should be explained. Discount rates and/or IRR hurdle rate of return may be discussed in relation to project risk and the estimated project merit measures.

22. **Summary** - A brief discussion of the important features of the project, conclusions and recommendations for further work are located in this section.

23. **Maps** - Folded maps may be located in the back of the report or in the relevant section. Page size maps should be integrated into the text that discusses them. The report will include both page size (8.5”x11” to 11”x17”) and full size maps (printed on the roll paper plotter) at least 24” wide. Map construction details are the same as MinE 483.

24. **Assumptions** – Each topic discussed in the design will have often not have sufficient data and require assumptions that you will select and identify as you discuss each issue. In addition, you may want to summarize the major assumptions in one place for the convenience of the reader.

25. **References** - Use a standard system of referencing quoted material and information either in a separate section or on the first referenced page it occurs as a footnote. Include citations in the text.

26. **Appendices** - Any large amount of data or tables, vendor information, computer output, and long calculations may be moved to the appendices.

27. **Executive Summary** - A one-page summary of the social, environmental, geologic, production and economic highlights of the project should be written after the body of the report is completed. Select one page-size map to include with the text to orient a knowledgeable reader about the project. The Executive Summary is located after the Letter of Transmittal.

28. **Letter of transmittal** – a letter of transmittal to the Chair of the Department of Mining Engineering is placed in the front of the report.

**The descriptors of evaluation criteria for each writing assignment are as follows:**

*(19-20 points)* This outstanding written product reflects excellent content, clarity, writing style, and mechanics. It is well organized and logically developed. The concepts are presented concisely. Mining, geologic and economic information is accurate and complete. Maps and illustrations are annotated clearly and consistently throughout. Content is highly appropriate for the target industry or financial audience. Information contained within the paper would require no revisions prior to presentation to a professional society, senior management or client.
This very good written product is well organized. There are minor errors in content, clarity, writing style, and/or mechanics. Mining, geologic and economic information is accurate. Maps and illustrations are annotated appropriately and consistently in most instances. Minor changes in content and conciseness would lend strength to the paper. Information contained within the paper would require very little revision prior to presentation to a professional society, senior management or client.

This satisfactory written product shows a moderate degree of organization, content development, clarity, writing style, and/or mechanics. Greater than 75% of the mining, geologic and economic information is accurate. Maps and illustrations are annotated but not in a consistent manner throughout. Information contained within the paper would require some revision prior to presentation to a professional society, senior management or client.

This sub-standard written product shows a lack of appropriate organization, content, clarity, writing style, and/or mechanics. Greater than 50% of the mining, geologic and economic information is accurate. Maps and illustrations are lacking or not annotated appropriately. Presentation of this report would be inappropriate and could jeopardize the reputation of the mining engineer writing the preliminary feasibility study. This paper requires extensive revisions prior to submission.

This is an unacceptable written product with regard to appropriate organization, content, clarity, writing style, and/or mechanics. Mining, geologic and economic information is inaccurate. Maps and illustrations are incomplete. Inclusion of this mining and geologic information could seriously jeopardize the reputation of the mining engineer writing the report and mislead the client.

The total points earned for a given writing assignment will be converted to a percentage. All six writing assignments will be weighted and summarized to equal 50% of the total course grade as shown above.

Class Policies

Attendance - Class normally meets two times per week and at least one meeting will be a long class period. 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 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. A library of mining reference books is maintained in the Mine Design Room and is NOT to be removed from the room. 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 room during normal office hours from 6 AM to 6 PM. Upper class students and grad students are given evening and weekend privileges. A PIN number is required to open the lock after normal hours. Do NOT leave the door open when out of the room for any reason.

**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 student initiative. Each assignment will be discussed 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 the following week. Students have the option of revising the assignment for regrading if returned within the following week. All copies of drafts with comments on them must be submitted with any subsequent revision. Assignments turned in up to one week late 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 are no excuses for plagiarism on material presented in the mapping or written assignments. Always credit your sources. Short quotes from reference material are acceptable if the source is noted. Only a project team member may write the report text and all team members are responsible for the entire report.

**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. It is recommended that you keep the assignments in a three ring binder for ease of organization and
updating pages. Style, font, text size, arrangement, page 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.

**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 CDROM. Special arrangements may be necessary for reporting or keeping proprietary data confidential. 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 complete 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. Appendices with backup material, vendors’ pull sheets or detailed printout will be the last section in the report or included in a separate volume. The non-confidential student report may be submitted to outside evaluators for independent assessment or mine design contests.

**Oral Presentation** - the oral presentation of 30 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 required. This presentation will be scheduled during normal class time if possible, at the end of the term, 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.

**Reference Guidelines** - A standard system of referencing selected by the authors will be used consistently for 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 senior year).

**Social Justice Statement**

West Virginia University is committed to social justice. We concur with that commitment and will foster a nurturing learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise us and make appropriate arrangements with Disability Services at 293-6700.