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AN APPROACH TO THE OPTIMAL DESIGN OF A COAL MINE

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PREFACE

This book is called "An Approach to the Optimal Design of A Coal Mine". It has been especially prepared for Doncaster Institute of Higher Education, Doncaster, England, which has an agreement of scholarly exchange with our institute, Shandong Institute of Mining and Technology. I have been invited to Doncaster to give lectures for two months from February to April, 1987. This material also has been prepared for Class 83-1, the Trial English Class, in the Mining Department of our institute. Most of the courses that those students study during their school year are taught in English and are aimed at simultaneously improving the student's English level and teaching engineering.

There are many ways to package this material in designing a course. Every topic is divided into several parts with graded levels of difficulty. Therefore, this material is well suited for a relatively wide range of student capability. It is aimed largely at the senior undergraduate level and second year graduate students. This material has great flexibility. Part 1 of each topic provides fundamental knowledge of that topic; part 2 of each topic offers application of this knowledge to mining problems. Reference articles are given as appendices in the back of the book.

Another purpose in compiling this material is to provide an opportunity for students and teachers in mining fields to study both the technical methods of optimal mine design and the scientific and technological English terminology of mining system engineering.

I know that this material would indeed be much better if I had native fluency in English. I hope that readers, whoever they might be, will give me constructive criticism and suggestions for improvement in preparation for the second edition of this material.

I am deeply indebted to many people for their part in making this book possible. I would like to acknowledge particularly the help of Mr. Russell Davis who is an English teacher at our institute for his tireless correction work.

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December 25, 1989

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CHAPTER ONE

Mine Design in China
——An Overall View

1.1 The Basis and Procedure of Mine Design

The Importance of Mine Design

Mine design is an important link in the capital construction of the coal industry. The quality of mine design basically determines the speed of mine construction and the stability and safety of coal production.

Mine design forms the basis for China's optimal development of coal resources through the planning of coal mine capital construction, control of investment, and organization of equipment and material supply. It involves many related industries and enterprise units. It is thus clear that mine design necessitates a comprehensive study which includes political, economic and technological considerations. Therefore, it is necessary to adhere to the scientific principle of seeking truth from facts and overcoming an unproductive style of work.

The Basis of Mine Design

Constructing a modern coal mine not only costs thousands of millions of dollars but also relates to the stable development of a national economy. Therefore, we must have sound principles for design of modern coal mines. In general, the basic design rules are as follows:

1. *Instruction for Design Work*

An instruction for design work, also called an instruction for planning work, is a document with a command characteristic which is made by production and management sectors to entrust the design sector with the design work. In the document, the design content, technical rules, design stages, design principles, plan arrangement, development plan, and the requirements for the related auxilliary projects are clearly defined. Therefore, the instruction for design work not only helps to implement the national plan but also reflects national need. Once instruction for design work is approved by the appropriate national ministry, the document takes immediate legal effect. No one apart from the ministry itself has the right to change it. When necessary, the authorizing office which gave the instruction for design work approves a complementary detailed instruction for design work. The instruction for design work forms the basis for determining the capital construction pro-

ject and compiling the design document. Its basic contents should be as follows:

(1) Define the aim and task of construction, explain the significance of conducting the project, and how it will fulfill the national need, and state the geological information and classification of the exploration (the degree to which the exploration is made).

(2) Expound on the scale of mine construction, the products planned, the production plan, and techniques used. This should include the underground development of the mine take, the preparation of the mining-district and the working system, the degree of mechanization, and the method of transportation.

(3) Detail the deposit resources, hydrogeology, geology, fuel, power, water supply, and external conditions such as external transportation, water resource data, the route of the power supply, equipment maintenance and technical conditions affecting the mine excavation (gas, coal dust, mine inflow, and so on).

(4) Comprehensively use the resources and note the need to avoid the "three wastes"(wasting water, wasting gas, and wasting material).

(5) Include a detail of the construction site, an estimate of the site area, and state the standards for buildings and the ratio oetween single workers and workers with families.

(6) Note the requirements for air defence and earthquake protection.

(7) Define the standard of the mine going into operation and the time needed for construction.

(8) State the amount of investment required.

(9) State the overall production efficiency and the fixed number of staff and workers.

(10) State the expected profits and the technical level required to reach those profits.

2. *Geological Data*

Geological data is a prerequisite of mine design. It is also the factual basis with which the state plans and develops the national economy. Therefore, it is required that geological data has high accuracy and integrity.

Geological data can be gained from three basic sources: coal field reconnaissance surveys, detailed regional exploration, and detailed mine investigation.

(1) The Geological Report of A Coal Field Reconnaissance Survey

A coal field reconnaissance survey is conducted in an area which is recognized to be worthy of exploration. The major task of the survey is to assess the value of developing the area and to provide the necessary information for the prospective plan of the coal industry and for the next phase of the exploration.

(2) The Geological Report of A Detailed Regional Exploration

The detailed regional exploration is conducted on the basis of the reconnaissance survey in an area which is rich in resources and deemed worthy of development. The major task of the exploration is to provide geological data for the overall regional plan. The result of the exploration should be accurate enough to ensure that the regional output and the location of the mines in the mining region suit the actual geological conditions. The report also assesses hydrogeological and other mining conditions which affect resource development.

(3) The Geological Report of A Detailed Mine Field Investigation

A detailed investigation of a mine take is conducted on the basis of the overall regional plan. Its major task is to provide reliable geological data for the primary design of a mine. The result of the investigation should satisfy the requirements for selecting the shaft and main roadway location, determining the initial mining-district, and ensuring that the planned boundary and planned capacity of the mine accurately anticipate the actual geological condition and that any changes in coal type have no effect on fixed industrial usage of the coal resources. In particular, a detailed investigation of a mine take should satisfy five standards as follows:

(*a*) Ensure an adequate service life time for the first level and normal production of the initial mining-district according to the resource conditions;

(*b*) Ensure thorough knowledge of the geological structure within the boundary of a mine take;

(*c*) Ensure that there are enough coal reserves to maintain stable mine capacity;

(*d*) Ensure that there are the appropriate types and qualities of coal to fulfill planned usage;

(*e*) Ensure that mine construction and initial production can be carried out normally on the basis of hydrogeological conditions.

The geological report of the detailed regional exploration and the geological report of the detailed investigation of a mine take are ,in general, approved by a group consisting of geological, design and production experts which is organized by the Committee of the Coal Reserves in the Coal Ministry. After approval, the geological reports can be used to provide the design basis for the design sector.

3. *Overall National Construction Policies and Related Regulations and Norms*

China is a country whose socialist economic system aims to develop the national economy in a planned way. To develop the capital construction of the coal industry healthily, the various general and specific policies, regulations, norms, and technical guides which are officially issued by the government and relate to a particular project must be followed for the basis of design.

4. *The Approved Design Principles*

The design principles and technical guides determined in the preceding stage and approved by the government must be used as the design basis for the following stage. For example, the division of the coal field into mine takes and the allocation of mine capacity and mechanical equipment which was determined in the overall regional plan must be followed in preliminary mine design. Only under extraordinary conditions can the design be changed. Similarly, the principles determined in the preliminary mine design must be followed in the working drawing design with only a small modification allowed.

The Procedures of Mine Design

1. *The Procedures of Mine Design*

In order to launch mine design work in a planned way, it must be conducted stage by stage according to design procedures. The conventional procedure which used to be employed went from "the overall regional plan—the preliminary mine design—the working drawing design". In recent years, however, mine feasibility studies have become one of the mine design stages as techniques

and management in the coal industry developed. According to the Document No [81] 30 issued by China's State Council concerning mine feasibility studies, all large or medium scale projects which will be built can be placed in the national plan after the responsible institution has submitted project reports concerning the products planned, the geological condition of the coal reserves, and the condition of raw and processed materials, electricity, water and coal transportation, and so on. The feasibility study must be submitted to the responsible authority regardless of the source, whether it be private or public, of the capital funds used in the mine project together with the Instruction for the Design Work issued by the National Planning Committee and the design documents approved by the National Construction Committee. In addition, Document No [81] 30 states that the responsible institution and associated units have full responsibility for the accuracy of calculations and for truthfully portraying all conditions. The responsible institution is duty-bound to answer for loses caused by mistakes. It is thus clear that the work of the mine feasibility study is not only serious but also very important. According to Document No [81] 30, mine design procedure is as follows: the regional construction feasibility study $\xrightarrow{\text{approved}}$ the overall regional plan $\xrightarrow{\text{official written reply}}$ mine feasibility studies $\xrightarrow{\text{approval}}$ the preliminary mine design $\xrightarrow{\text{examination and approval}}$ the working drawing design.

2. *The Importance of Observing Design Procedure*

The design procedure for coal mine capital construction is in fact a summary of practical experience in capital construction during many years and reflects objective laws of coal mine construction. Therefore, adhering to design procedure is the key to ensure quality in mine design and speedy capital construction of a coal mine.

The following sections will discuss the overall regional plan, feasibility studies, and preliminary mine design according to the above-mentioned mine design procedure.

1.2 The Overall Regional Plan

The Principle of Compiling An Overall Regional Plan

The overall regional plan is a strategic work conducted according to the requirements of national economic development. The aim of compiling the overall regional plan is to reasonably develop the resources in an entire mining area and to determine a major regional development plan so as to provide a design basis for compiling the regional construction plan and individual project designs in the region.

In order to fully understand and analyze a region's development, the overall regional plan considers technical policies issued by the Party and the State, coal demand, resource conditions (characteristics of coal deposits), mining conditions (manpower, materials and financing), technical levels, and so on. The relationship between industry and agriculture, the near future and the distant future, shallow deposits and deep deposits, coal output and coal type, the mining region and the related enterprises—all should be correctly dealt with so as to make a rational distribution of coal mines. In general, the distribution of coal mines includes consideration of the principle of developing shallow deposits first and deep deposits afterwards, easily mined deposits first and more difficult

ones afterwards, and conveniently located deposits first and more remote ones afterwards. In the development of a coal mine, the sequence is to employ an open pit first and an underground mine afterwards, and an adit first and an inclined shaft or a vertical shaft afterwards. Mines which have simple construction and production conditions, require less investment, will reap benefits quickly, or have convenient transportation, electricity, or water and material supply have priority to be developed first.

In accordance with this policy, the following points should be considered:

(1) After the shallow reserves in a mining area have been reasonably developed to a certain extent, the deep reserves in that area are only considered to replace the production capacity of the shallow part of a mine.

(2) New mining areas near old areas can be used to expand the production capacity of the old area, if it is rich in coal reserves, has good mining conditions, or if the state is badly in need of coal.

(3) New mining areas which are rich in coal reserves and have good mining conditions but have construction difficulties such as a thick surface soil layer, running sands or complex hydrogeological conditions should be developed by widely distributed large scale mines. In the arranging the construction sequence of the mines in the area, one to two mines should first be developed, further construction should be considered only after the experience in the construction and production is obtained.

(4) When working out the overall regional plan, the concentration of mines' distribution should be considered so as to fully exploit the capacity of railway transportation and the power supply system.

(5) If a mining region has flat or gently-inclined coal seams, a large size on strike and regional production capacity cannot satisfy planned output, then the shallow and deep deposits in the region should be mined simultaneously in order to avoid the dispersion of mines.

(6) Construction in a region which has different types on quality of coal is arranged according to the national need.

(7) A large scale mine design should be considered for a mine take which is rich in coal reserves, has a large output capacity, and presents good mining conditions. Small or medium mine designs should be considered for a mine take which is difficult to mine or has complex geological structure. The area of a take and the production capacity of a mine in a mining region which has coal in deep burial, a complex topography, or presents difficulty in mine condition should be enlarged to reduce mine density.

(8) A regional plan should take into consideration of the rational concentration of production, the simplification of the transportation system, the economic use of land, and the construction of a centrolized surface production system.

The Contents and Requirements for Compiling the Overall Regional Plan

The overall regional plan aims to solve the problem of the overall distribution of mines in regional development. The relationship between the mining region and the mine reflects the relation-

ship between the whole and the individual or local. Whether or not the relationship between them is rational depends on the relative accuracy of the overall regional plan principles that were mentioned in section one.

The overall regional plan has a wide scope which includes the division of the coal field into coal mines, the determination of rational mine scale, the consideration of all auxilliary and subsidiary enterprises, and administrative, cultural, sanitary and living facilities.

The contents of the overall regional plan are as follows:

The basis and principle idea for the design of the overall regional plan are entirely described in detail in the introduction. The rationale behind the regional development, the economic benefits gained, and the significance for the development of the national economy are described. Finally, the introduction indicates problems that exist and proposes solutions.

Chapter one which is a general description of the mining region, describes in general the location of the mining region and transportation facilities, the national economic development in the area, the distribution of industry and agriculture, and the supply of water, electricity and materials. Included in this chapter are also descriptions of geological characteristics of the coal field (in a survey of coal seams, coal quality and hydrogeological conditions), the level of exploration of the reserves and any other materials that might be in the area.

The next chapter on regional development, introduces mines (or open pits) which are in production or under construction in the region, the division of the mining region into takes, mode of the development of mine takes, the production scale of the mining region and the mine construction sequence in the region. The regional construction sequence here includes the sequence of individual projects and the planning table for the growth of coal output in the region.

The succeeding chapter on coal washing and processing discusses coal quality, the washability of coal, the selection of the coal processing technique, the layout of the coal preparation plant and the screening plant, and the storage and loading system for raw coal.

The next chapter presents the layout of the regional surface facilities and the installations for flood control and drainage.

The auxilliary and subsidiary enterprises chapter details the installations of these two concerns. The description of the auxilliary enterprises includes the size, number of staff, location and construction sequence of the projects. Also outlined are regional electric-mechanical repair and spare parts plants, prefabricated components plants, general materials and explosive storage facilities, truck teams, rescue teams, and timber yards. The description of the subsidiary enterprises includes cement plants, waste-brick yards, lime-burning kilns, quarries and multipurpose plants.

In the chapter on administrative, educational, medical and residential facilities, regional coal administration projects and subsidiary organizations should be described. The description includes such facts as the scale of regional high schools and hospitals, the size of the fire-fighting teams and rescue teams, the construction standard of the residential areas, the ratio of single workers to those workers who have families, and so on.

In the chapter on surface transportation, the amount of coal transported, number of consumers

served and transportation equipment used are introduced. The overall plan should take all factors into consideration, including regional rail, highway and waterway systems, to arrange the coal transportation.

The next chapter describes the power supply and communication systems.

The water supply and drainage chapter introduces the hydrogeological conditions, water sources, water supply systems, water drainage capacity and facilities and equipment in the water drainage system.

The description of the regional flood prevention and water drainage project includes an outline of a unified plan which considers the comprehensive use of by-products, the avoidance of the "three wastes" (waste of water, gas, and materials) pollution factors, measures taken for environmental protection, and regional afforestation.

The final chapter covers regional economic issues and includes estimates for production growth rates, the fixed number of staff and workers, the capital construction and materials investment, the regional investment in individual projects and the distribution tables for annual regional investment, and the material demand (steel, wood and cement) for individual projects and the accompanying annual distribution tables. Other topics included in this chapter are major technical-economic parameters and analysis and an overall description of the division of the coal field into mine takes, the mine development sequence, construction scale, economic benefits, and so on.

1.3 Mine Feasibility Studies

A feasibility study is a comprehensive report on the geology, construction, mining, marketing of coal, and the capital and operating costs of a mine. It is prepared to determine the estimated earnings, cash flow, and economic viability of the mine under examination. Feasibility studies are prepared in varying degrees of accuracy, at various stages of exploration and mine development, and for a variety of purposes. The degree of accuracy of a study is reflected in the time and money invested in it. The information produced by the study is first analyzed by financial personnel to determine project viability and then used by mine management as one of the prime components in the evaluation of overall project risk or comparison among different project plans.

The Contents of Mine Feasibility Studies

Before compiling the regional overall plan and the preliminary mine design, one should compile respectively the regional feasibility study report and the mine feasibility study report. Although the function of the two reports is different, the contents and the evaluation methods are similar.

A feasibility study should be accurate and detailed enough to satisfy the following requirements:

(1) It can be used as the basis for compiling the instruction for design work after it has been approved by the appropriate authority.

(2) That part of the feasibility study concerning the coal consumers, the products planned, and the water, power supply, and transportation conditions can be used as the basis for any agreement between the mine and a related cooperating enterprise.

(3) After closely analyzing the approved geological report of the detailed exploration, one makes a comprehensive evaluation concerning resource reliability in the feasibility study. This evaluation can be used not only by the appropriate authority for decision-making but also as the basis for an agreement with related cooperating departments.

(4) Major considerations which affect mine construction, such as production capacity, mode of development, technical processes, and selection of main equipment are technically and economically described in many detailed schemes which give rise to an optimal plan. This plan can be used as the basis for compiling the design documents in the next stage and for making the plan for equipment manufacture.

(5) the accuracy of the investment estimate should be 70%. This estimate is used by a bank to approve project funds or by a mine owner to negociate and sign contracts for the project.

The general contents of a feasibility study are as follows:

(1) The prediction of market demand

Prediction techniques and marketing investigation stress study on the following problems: coal market demand (including coal markets abroad), customer opinion, the effect of possible coal substitutes on supply and demand, coal sales competition, and so on. Based on the above comprehensive study, we make a plan to satisfy present and future coal demand taking into account the requirements of consumers concerning coal quality and size.

(2) The study of coal resource conditions

Coal resource conditions form the basis for mine construction. Practical experience at home and abroad has demonstrated that mine design has to be modified many times over because initial geological information often has little integrity or reliability. A study of coal resource conditions must consider topography, drainage, overburden, ground water, regional and local geology, faulting and petrology and must provide a description of the geology and dimensions of the deposit in a coal reserves summary, the details and basis for coal reserve calculations and drill hole reports, and maps and drawings of coal seams.

(3) Coal mine production capacity

Determining the production capacity of a coal mine deponds on the following factors:

(*a*) Market demand is an important factor but not the decisive factor.

(*b*) The geological condition of the coal reserves forms the basis for determining the production capacity of a coal mine. A large scale coal mine can be considered for a coal field which has simple geological structure and good mining conditions. Contrarily, a small size coal mine should be built if the geological structure of a coal field is very complicated.

(*c*) The mining equipment used is also an important factor in determining production capacity. In the 1950's, the mining equipment used in China had low power capacity and yield a low production rate. In recent years, coal mining has been mechanized with fully-mechanized equipment employed in many mines, this makes production rates of 300～600 thousand tons of coal per face per year possible. Fully-mechanized mining made possible a record of 4.2 million tons of coal produced in one year with only four working faces in a mine in the Soviet Union.

(4) Development and mining

In considering development and mining, a feasibility study generally includes discussion of mine development alternatives, comparative cost estimates, the ultimate plan selected, the preproduction period development plan, the redivision of the mine take, and the mining method and equipment used.

(5) An overall plan for the surface facilities of the mine, environmental protection plans, the land plan for the mine yard and residential areas are included.

(6) A feasibility study makes a comprehensive balance of the overall project and the schedules for project construction and determines the time needed for mine construction and the use of capital funds.

(7) Economic analysis

The economic analysis in a feasibility study makes a comprehensive evaluation of the project based on the above studies and includes investment estimates, cash flow estimates, investment interest due during the construction period, the term for the return on investment (ROI), a sensitivity analysis, and so on.

After completing all the analysis of the feasibility study, it is usually necessary to adjust mine parameters in order to raise the economic benefit of the proposed project. Parameters such as production capacity, products planned, the dimensions of the working face and the mining district, and so on, may be changed so that the overall project can be optimized.

The Main Chapters, Sections, and Drawings of A Feasibility Study

In compiling the feasibility study report of a mine, one can refer to "The Contents of A Mine Feasibility Study Report for the Coal Industry" issued by the Bureau of Design Management of the Coal Industry in 1981. This document is now being implemented on a trial basis. Its abstract is as follows:

The General Description of A Mine Take

The general description of a mine take in a feasibility study includes an introduction, a technical-economic analysis and evaluation, and a description of existing problems and proposals. It provides the summarized conclusion for the appropriate department and should make important points stand out, clarify viewpoints, and should correctly and succinctly present its contents.

Chapter One Introduction of the Mine and the Construction Conditions

1. Introduction of the mine
2. The external conditions of mine construction
3. The resource conditions of the mine
4. Supply and market demand

Chapter Two Development and Mining

1. Mine boundaries and workable reserves
2. Planned production capacity of the mine
3. Development
4. Transportation in shaft, shaft bottom and main drift
5. Underground mining

6. Safety

Chapter Three Main Equipment of the Mine

1. Coal hoisting equipment
2. Ventilation equipment
3. Drainage equipment
4. Air compressing equipment

In selecting the above equipment, one must fully demonstrate the basis and priority for the selection

Chapter Four Surface Facilities

1. The layout of surface production equipment and facilities
2. Surface transportation
3. The overall plan of the mine yard
4. Power supply
5. Water supply
6. Industrial and administrative buildings
7. Residential area
8. Environmental protection and comprehensive utilization of by-products

Chapter Five Shaft Sinking Project

1. Procedure of mine construction
2. Duration of mine construction
3. Prediction of output growth

Chapter Six Economic Analysis

1. Productivity and manpower allocation
2. Estimates of investment and source of funds
3. Estimate of coal cost.
4. financial balance table
5. Economic analysis and evaluation
6. Main technical-economic indeces of a mine

The drawings of a feasibility study report for a mine are as follows:

(1) the topographic map of the coal field, 1:10000—1:50000.

(2) The topographic map of the mine, 1:5000—1:10000.

(3) Integrated stratigraphic columns, 1:200.

(4) The contours of the main seams and the reserve calculation maps.

(5) The main geological cross-sections.

(6) Mine development plans and cross-sections, 1:2000—1:5000.

(7) The plan showing the location of initial mining-districts which yield full production capacity.

(8) Plan and cross-sections of main surface production system.

(9) Plan showing the overall layout of mine yard, 1:5000—1:10000.

(10) Plan showing overall layout of the mine.

(11) The integrated time table for the construction and installation of shafts, roadways, buildings and mechanical-electrical equipment.

1.4 The Preliminary Mine Design

Preparation for the Preliminary Mine Design

After the feasibility study report of a mine is approved, one can begin to do the preparation work for the preliminary mine design so as to provide the basic information needed for the design. The preliminary mine design involves input from many fields including mining, mine construction, geology, surveying, and civil, mechanical and electrical engineering. Among them, mining plays a leading role. So, in general, a mining engineer is assigned as the person who is in charge of the project.

the preparation work that precedes the compilation of the preliminary mine design documents can be summarized as follows:

1. *Detailed Reading of the Geological Report and Checking the Design Basis*

Geological information provides basic data for mine design and construction and its reliability directly relates to successful mine construction and economic coal production. Designers should systematically read the geological data that is related to coal production and clarify whether the initial geological data can satisfy the mine design requirements. Mining design engineers are not only familar with the overall contents of the geological report but also stress study of the data which is related to mining. The main points are as follows:

(1) Geological characteristics of the coal deposit

For large or medium scale mines, find out the fault or folding axis to be used as the mine boundary and determine the number of faults whose throw is larger than 30m in the first level. Give an evaluation of degree of the development of the geological structures. Find out whether there are enough checking holes to adequately determine the places where the seam floor contours vary greatly in the first level. Find out whether the seam floor contours where the main drifts will be placed are clearly defined. Clarify the number, thickness, position and structure of coal seams and the mining area of the principal workable coal seams with a detailed study of the characteristics of the roof and floor, and guide seams. Discern the trademark of the coal, the coal quality, and include an industrial analysis of the coal and its usage. Check out all data from coal samples and chemical examination to determine coal washability. Check the coal reserves and the method used to calculate them, the ratio of different grades of coal reserves, and whether the coal reserves at all levels satisfy the requirements of the "Norms of Mine Design in the Coal Industry".

(2) Study of the hydrogeological data

Hydrogeological data form the basis for determining water drainage underground. The data includes information on the surface hydrographic net, aquifers, impermeable seams, goaf water, calculations of underground water inflow, and so on.

(3) Other factors affecting coal mining

All factors, such as the amount of gas in the formation, the spontaneous combustibility of coal seams, coal dust, underground temperatures, the area disturbed by goaf, and igneous intrusions, have a great effect on safe mine production and must be contained in the geological report.

2. *Verifying the Contents Determined in Preceding Designs*

The division of the coal field into mines is included in the feasibility study of a mine while the mine capacity and the development plan are determined in it. Although the feasibility study of a mine is based on detailed mine investigation, we must verify the design contents of the last stage to ensure that any changes in geological conditions are known.

3. *Working on the Topographic Survey and Engineering Geology*

(1) The topographic survey

According to the mine yard layout, the ventilation shaft site, the railway, the electrical transformer project and the residential area that have been determined in the recommended mine development plan, one can arrange the topographic survey. A topographic engineering map is produced after a survey of the area which has been decided upon by a design group which considers all mining, transportation, civil, mechanical, and electrical engineering aspects. Except for the scale of the topographic engineering map which should satisfy the requirements of the mine design; the coordinate system and contour scale of the above map should correspond with the mine topographic map.

(2) Engineering geology

During the mine feasibility study stage, although an on-the-spot geological engineering survey is made to help selecting the sites of the mine yard and other facilities and existing geological engineering data have been collected and studied, we still need to do further geological engineering exploration in order to select the mine yard site before the preliminary mine design is launched. The main task at this stage is to provide data for the overall plan layout of buildings, the base plan for main projects, and protection measures for areas which have bad geological conditions. Therefore, the geological engineering stage includes surveys that are necessary to determine the physical-mechanical property of rock and soil in the building area, the permitted bearing force of base rock and mud, as well as the location and degree of development of any disturbined areas.

(3) Othef preparations

If the reliability of information concerning coal seams is not good in the areas where there are mining-districts which help ensure that the mine will go into operation and quickly reach production capacity, the appropriate department should order additional drillings to guarantee the reliability of design information. For example, in order to ensure reasonable shaft positions and to avoid shafts passing through danger zones, one must drill shaft-checking holes. Although this drill data cannot be used for the preliminary mine design, it can be used for the working drawing used in the next stage.

the Contents of Preliminary Mine Design

1. *The Components and Requirements of Preliminary Mine Design*

The contents of a preliminary mine design vary widely. A preliminary mine design document should include a technical manual for the preliminary mine design, a description of main mechanical-electrical equipment and materials, a budgetary estimate manual, and a detailed list of the use of the three materials (steel, cement and wood) and attached drawings.

A preliminary mine design should include a description of the comparison and selection process