

PART B - MINING II : Mining Technical Services (Coal)

A. Sustainable development.

1. **Key aspects of sustainable development** – role of mining in the community, environmental care, due diligence, social responsibility, the role of ethics, operating within the legal framework, influencing the legal process
2. **Due diligence**
Application of due diligence, risk assessment and risk management, International Standards, audits, competent persons, Codes of Practice in business, quality assurance
3. **The mining environment**
Environmental Impact Assessments, environmental protection and management reports, rehabilitation provisions, threats to the environment from underground and surface mining and means of managing the risks, interested and affected parties, legal requirements, Ministries involved, effects of litigation
Pollution products and their effect on the human being – the natural environment
Economics of minimizing the pollution products. Control of pollution and environmental conditions – standards (legal and moral) – measurements with and the use of instruments – reports and recommendations.
Monitoring systems – subsidence, water pollution, dust, noise, toxic waste
Means of treatment of pollutants
Environmental protection.
4. **Economic impact of mining** – the Minerals Policy Document, economics of mining, effects on community before, during and after mining, taxation, levies, education and training, employment.
5. **Selected technical literature**
Minerals Policy document: Department of Mineral and Energy
Environmental Management in South Africa: R.F.Fuggle, R.A.Rabie, Juta & Co Ltd., 1994.

B. Environmental Engineering.

1. **Airflow.**
All aspects of airflow on collieries - control - calculations - pressure surveys - fans and fan curves - fan laws - economics of fan and layout selection.
Modeling and simulation techniques
2. **Detail of pollution and pollution products**
Gasses and dust. Dust control in opencast and underground collieries. Light and illumination. Sound and noise. Water and purity. Fires and explosions. Sanitation. Ventilation planning, plans and ventilation equipment. Legal limits, pathological effects and treatment.
3. **Risk assessment and analysis.**
Assessment of risks, audits, monitoring systems. Risk assessment applied to design. Management of risks. Risks associated with different mining methods.
4. **Roles of management.**
Employees and environmental personnel in managing environmental risks
5. **Occupational Hygiene.**
Roles and Duties of Occupational Hygienists.
6. **Directives and Guidelines pertaining Environmental Engineering**
 - Directive B3 : Dust Sampling Strategy
 - Directive B5 : A Guideline for the Siting, Construction, Equipping and Maintaining of Refuge Bays
 - Directive B6 : A Guideline for the Monitoring of Self-contained Self-rescuers
 - Directive B7 : A Guideline for the Ventilating of Mechanical Miner Sections
 - Directive B9 : A Guideline for a Code of Practice for Lamprooms, Covering Gas Detection Instrumentation, Self-contained Self-rescuers and Portable Lamps
 - Directive B11: Testing for Flammable Gas under unsupported areas in Coal Mines
 - Directive B13: Guideline for the Prevention of Coal Dust Explosions in Underground Coal

Mines

- Directive B24: The Effectiveness of Stone Dust for the suppression of Coal Dust Explosions

7. **Selected technical literature**

Environmental Engineering in South African Mines: The Mine Ventilation Society of South Africa, 1989

The Directives and Guidelines are available from the Regional Offices of the Department of Minerals and Energy

C. **Risk Management.**

1. **Theory and application of risk management**

Baseline, continuous and issue based risk assessments. How they are applied in technical areas. Systems used in each area.

Risk management techniques. Means of managing, minimizing or eliminating risk.

Computer methods and simulations.

The Manager's role in risk management. Due diligence.

2. **Emergency preparedness.**

Risk assessments translated into emergency plans. Monitoring systems, measurements.

Competent people, emergency teams, control rooms, responsibility of appointed persons.

Contingencies to be prepared for. Impact and inclusion in mine design.

3. **Emergency management.**

Fires and spontaneous combustion – explosions – flooding – major rockfalls – labour unrest – emergency services – protection equipment and procedures. Prevention and dealing with these hazards e.g. stone dusting and stone dust barriers.

Emergency control rooms, procedures and responsibilities. Assessment of damage, safety of persons.

D. **Rock Engineering**

1. **Fundamentals.**

Basic definitions – Units, mass, force, density, normal stress, shear stress, strain, energy, elasticity, uniaxial and tri-axial state of stress, Elastic Modulus, Poisson's ratio, equilibrium.

Beams / plates – Clamped beams, cantilevers, fibre stresses, deflections.

Friction - Friction coefficient, normal stress, shear stress.

2. **Physical environment.**

Geology – For each coal district: Overburden composition, seams, thicknesses, roof and floor compositions, tectonic plates, sills, dykes, faults.

Mechanical characteristics – Compressive, shear and tensile strength, Elastic Moduli of lithological units. Roof rating methods.

In situ stress state – Vertical stress, horizontal stress, shear stress, effects of dykes and faults.

3. **Roof support.**

Factors that influence roof stability – Composition of roof, road width, horizontal stress, dykes faults, joints, time of support, cut-out distance.

Roof support system design philosophies – Maximum road width without support, suspension beam creation – under which conditions which is required.

Roof support units – Characteristics of mechanical anchors, resin point anchors, full column resin tendons, split sets, trusses, long cable anchors, steel sets, arches, shotcrete, elastic sprays.

Roof support elements – Characteristics of tendon, thread, washer, nut, crimp nut, nib bolt, slow and fast resins, grouts, injection materials (silicon compounds, polyurethane), hole and tendon diameter. Standing supports: mat packs, timber poles, cluster sticks.

Roof support design methods – Type of bolt, spacing, length of anchors, pre-tension.

Installation – Installation procedures for mechanical anchors, resin anchors, split sets, trusses, arches, injections. Sequence of installation, cut-out distance. Temporary supports.

Monitoring and control – Colour coding, visual observations of roof falls and appearance of installed bolts, tell tales, extensometers, petrosopes. Mapping of roof falls, identification of trends, identification of hazardous structures. Effects of non-conformances of hole length, hole diameter. Storage of resin, rusted bolts.

Ribside support – Where required, support elements, steel versus fibre, mesh, wrapping, spraying, shotcrete.

4. Bord and Pillar mining.

Safety factor and failure probability concept, different formulae, safety factor calculations, panel width, pillar width, road width, mining height, directional control, effects of deviations from planned lay-outs, control measures. Requirements for main development, production panels, undermining of public structures. Effects of time on pillar strength. Floor and roof conditions.

Blasting vs Continuous Miner development, corrections to formulae. Rectangular and parallelogram pillars.

5. Stooping.

Stress distribution before and after full goaf, effect of dolerites and massive sandstones, pillar sizes, road width, sequence of stooping, method of extracting pillars, canopies, position of Continuous Miner operator, remote controls. Snooks, correct size, over- and under size.

Emergency operations: recovering buried Continuous Miners. Precautions when stooping old pillars.

6. Longwalling.

Stress distribution before and after main goaf, effect of dolerite sills and massive sandstones, chain pillar design, shield design, face shape, panel width, equipment extraction methods under strong and weak roof conditions, rate of mining, unplanned stoppages. Emergency operations: face break recovery, handling spalling faces.

7. Pillar splitting and partial stooping.

Pre- and post splitting safety factors, panel width, effect of overburden strength and thicknesses of lithological units. Where to split, where to checker board. Precautions: leaving lines of solid pillars, disadvantages. Violence of failure, effect of width to height ratio. Effects of wind blast.

8. Multiple seam mining.

Effect of parting thickness, parting composition, interaction of seams, super imposition, sequence of mining, combinations of bord and pillar, stooping and longwalling.

9. Service excavations.

Shafts, sinking methods for different geology, support, monitoring, bunkers, workshops.

10. Subsidence.

Elements of subsidence – vertical subsidence, horizontal displacement, compressive and tensile strain, curvature, tilt. Typical South African subsidence, effect of dolerite and massive sandstones. Effects of subsidence on typical surface structures: conveyor belts, power pylons, roads, pipelines, dwellings. Precautions for undermining of each.

Effects on agriculture – ponds, ground water, erosion, fences.

Long term effects – sub surface erosion, early detection, prevention, handling.

11. Codes of Practice.

Guidelines, Tripartism, difference between Codes Practice and Mine Standards, legal implications, duties and responsibilities of manager and rock engineer. Review procedures.

12. Legal aspects.

Mine Health and Safety Act, enquiries, safety committees, powers and responsibilities of Safety Representatives, Safety in Mines Research Advisory Committee (SIMRAC) contributions, responsibilities of material suppliers. Mine closure.

13. Old mines.

Possible surface effects, pillar failure, intersection collapse, stooping old pillars.

14. Selected technical literature.

Practical Coal Mining Strata Control (Second Edition), JN van der Merwe, ITASCA Africa, Johannesburg.

Mine Health and Safety Act, DME, Pretoria

SIMRAC Reports, SIMPROSS, Johannesburg

Guidelines for the Compilation of Codes of Practice to Combat Rock Related Accidents on Coal Mines, DME, Pretoria

E. Infrastructure

Conveyor Belt Systems. Selection, Design and Applications

Flow properties of Coal

Water reticulation and pump systems

Underground Dams and Seals

F. Mineral Resource Management

What is Mineral Resource Management?

Economic definition and potential of coal deposit

Planning for optimal extraction

Tools and systems for Mineral Resource Management

Feasibility studies and valuations

Cutoff qualities and profitability

Mine design economics

Effects of new technology on value

Forecasting and life of mine calculations. Short and long term planning. Life of mine estimates.

Revenue and cost estimates.

G. Coal Preparation

Beneficiation plants

- Coal flow

- Operations

- Types

Washability curves – proximate analysis – consistency bands – coal reserves.