# Coal Mine Ground Control

## Third edition

### Table of Contents

1. **Mine Layouts and Ground Control Practices in U.S. Coal Mines**
   1.1 Definition of Ground Control
   1.2 U.S. Coal Mining Methods and Production
   1.3 Coal Mine Layouts and Ground Control Practices
   1.4 Ground Control in Coal Mining
   1.5 Interaction of Ground Control with Other Subsystems of Underground Coal Mining

2. **Rock Properties and In-Situ Stresses**
   2.1 Introduction
   2.2 Basic Rock Properties
   2.3 Determination of Rock Properties
   2.4 Strength of Rock/Coal Obtained in the Laboratory
   2.5 Failure Criteria for Coal Measure Strata
   2.6 Major Factors Controlling Rock/Coal Behavior
   2.7 In-situ Stresses

3. **Geology and Geophysics**
   3.1 Introduction
   3.2 Coal-Forming Depositional Environments
   3.3 Discontinuities (Anomalies) of Coal and Its Surrounding Rocks
   3.4 Coal Measures Rock Strata
   3.5 Geology, Ground Control, and Mine Design and Planning
   3.6 Detection of Geological Anomalies by Geophysical Methods

4. **Roof Bolting**
   4.1 Introduction
   4.2 Type of Bolts
   4.3 Tensioned Bolts
   4.4 Non-Tensioned (Passive) Bolts
   4.5 Fully-Grouted Tensioned Rebar Bolts
   4.6 Trusses and Sling
   4.7 Roof Bolt System Hardware
   4.8 Mechanisms of Roof Bolting
   4.9 Methods for Designing Roof Bolting Systems
   4.10 Drilling of Bolt Holes
   4.11 Nondestructive Testing of Bolt Failure
   4.12 OneStep Bolts

5. **Coal Pillars**
   5.1 Introduction
   5.2 Factors Affecting Pillar Strength

5.3 Pillar Design Methods
5.4 Yield Pillar
5.5 Barrier Pillars
5.6 Modes of Pillar Failures
5.7 Long-Term versus Short-Term Pillar Strength
5.8 Pillar Extraction
5.9 Web Pillars for Highwall Mining
5.10 Dewatering and Pillar Strength
5.11 Pillar Design for Gas/Oil Wells
5.12 Case Examples-Pillar Dimensions Using Various Design Methods

6. **High Horizontal Stresses**
   6.1 Introduction
   6.2 Effects of Horizontal Stress Orientation and Cutting Sequence on Entry Stability
   6.3 Cutter Roof and High Horizontal Stresses
   6.4 Effects of Topography Under High Horizontal Stress
   6.5 Intersections of Entries and Crosscuts Under High Horizontal Stress
   6.6 Geological Anomalies and Horizontal Stress
   6.7 Stress Mapping
   6.8 Horizontal Stress and Roof Supports
   6.9 Complete Stress Analysis and Application of High Horizontal Stresses

7. **Longwall mining**
   7.1 Introduction
   7.2 Panel Layout and Gatroad Systems
   7.3 Overburden Movement
   7.4 Abutment Pressure and Gatroad Convergence
   7.5 Shield Design
   7.6 Roof /Rib Falls and Floor Heave at Longwall Faces
   7.7 Effect of Panel Width
   7.8 Faults and Geological Anomalies
   7.9 Gatroad Pillar Extraction
   7.10 Pre-driven Recovery Room and Mining Through Open Entries
   7.11 Hard-to-Cave Roof
   7.12 Bridging and Cyclic Failures of Strong Roof Layers
   7.13 Headgate and Tailgate Supports
8. Multiple- Seam Mining
8.1 Introduction
8.2 Sequence of Multiple- Seam Mining
8.3 Interaction Factors
8.4 Interaction Mechanisms
8.5 Ultra- Close Multiple- Seam Mining
8.6 Design of Multiple- Seam Mining Plan
8.7 Three- Seam Mining
8.8 Multiple- Seam Highwall Mining

9. Bumps
9.1 Introduction
9.2 Occurrence of Coal Bumps
9.3 Causes and Mechanisms of Coal Bumps
9.4 Magnitude and Damage of Coal Bumps
9.5 Methods of Bump Control
9.6 Prediction of Bumps by Microseismic Method

10. Roof/Rib Falls and Floor Heaves
10.1 Introduction
10.2 Roof Falls
10.3 Cutter Roofs
10.4 Rib Falls
10.5 Shale and Its Role on Mine Roof Stability
10.6 Floor Heave

11. Instrumentation
11.1 Instrumentation
11.2 Load- Measuring Devices
11.3 Stress- Measuring Devices
11.4 Deformation- Measuring Devices
11.5 Strain- Measuring Devices
11.6 Bearing Capacity Tester
11.7 Borehole Observation Devices
11.8 Overburden Strata Movement Monitoring Devices
11.9 Longwall Shield Monitoring Devices
11.10 Borehole Penetrometer

12. Computer Modeling
12.1 Introduction
12.2 Methods of Numerical Modeling
12.3 Constitutive models of Coal/Rocks/gob
12.4 Calibration/Validation of Computer Models
12.5 Case Example 1 - Design of a New Room- and- Pillar Mine
12.6 Case Example 2 - Design of Longwall Gateroad Chain Pillars
12.7 Case Example 3 - Roof Bolting
12.8 Case Example 4 - Multiple- Seam Mining
12.9 Case Example 5 - Gas Well Stability
12.10 Case Example 6 - Surface Subsidence

13. Surface Subsidence
13.1 Introduction
13.2 Characteristics of Surface Movement
13.3 Effects of Geological and Mining Factors
13.4 Subsidence Prediction Methods
13.5 Final Subsidence in Hilly Regions
13.6 Final Subsidence Induced by Chain Pillars
13.7 Dynamic Subsidence and Subsidence Duration
13.8 Long- Term Subsidence
13.9 Surface Subsidence Prediction Software
13.10 Surface Subsidence Monitoring
13.11 Subsidence Influence Assessment and Mitigations
13.12 Final Subsidence over Irregular Mine Openings

14. Highwall Stability
14.1 Introduction
14.2 Highwall Characteristics
14.3 Factors Affecting Highwall Stability
14.4 Types of Highwall Failures
14.5 Failure Analysis
14.6 Portal Stability
14.7 Monitoring of Slope Movement
14.8 Surge, Spoil, Waste, and Truck- Built Stock Piles

References

Index

Appendix 1 MS Thesis and PhD Dissertations Supervised

Appendix 2 A Guide to Cored Rocks in U.S. Coalfields

Appendix 3 Figures and Photographs in Color