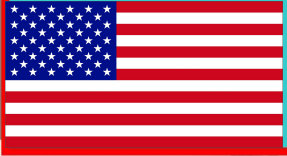


# FIVE- DIMENSIONAL WORKING POINT FOR ROOF BOLTING SYSTEM DESIGN IN COAL BURST CONDITIONS



ROCBOLT TECHNOLOGIES, CHINA  
ZIBO MINING GROUP



# CONTENTS

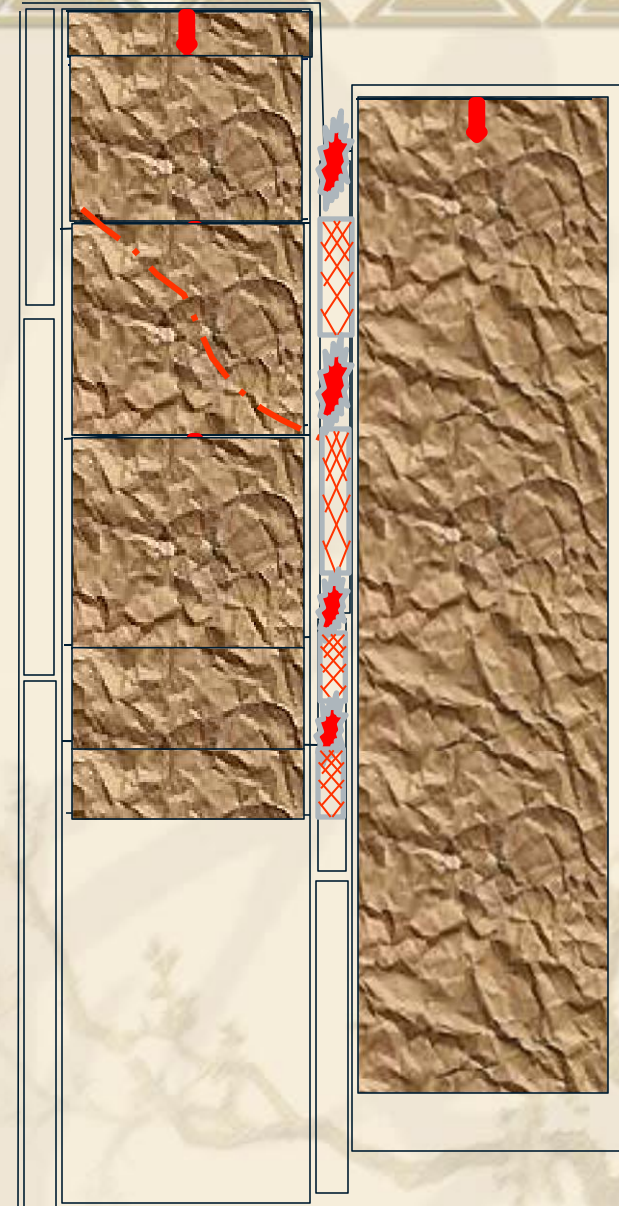
- **Project Background**
- **Coal Pillar Design**
- **Five- Dimensional Working Points Design**
- **Products Development**
- **Application Cases**

# PROJECT BACKGROUND

- **Overburden Depth: 200-1200 m**
- **Coal Pillar Width: 20-40 m**
- **Coal Burst: Overburden Depth > 400m**
- **Headgate and Tailgate Development**
- **Some Typical Burst Cases**
- **Problems to be solved**

# Bayangaole Mine

- ◆ 650m cover
- ◆ 30m pillar
- ◆ Burst Record
  - ◆ **First Burst**
    - ◆ 240 m from Setup room
    - ◆ Affected area 60m outby face line
    - ◆ Front Chocks damaged, cable and bolt broken
    - ◆ Floor heave, roof sagging and rib spall.
  - ◆ **Second Burst**
    - ◆ 453 m from Setup room
    - ◆ Affected area 100m outby face line
  - ◆ **Third Burst**
    - ◆ 680 m from Setup room
    - ◆ Affected area 60m outby face line
  - ◆ **Fourth Burst**
    - ◆ 791m from Setup room
    - ◆ Affected area 60m outby face line





# PROJECT BACKGROUND

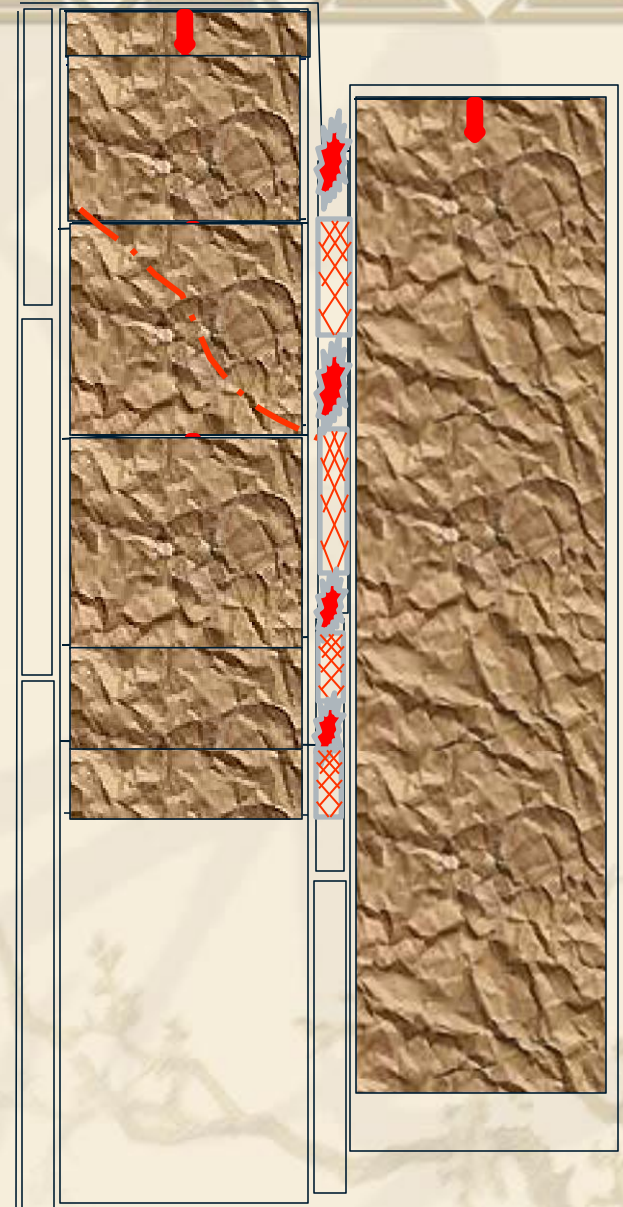
- **Some Typical Burst Cases**
  - **Baiyangaole Burst: 15 Bursts**
  - **Tingnan 10 Bursts**
  - **Gaojiabao: 10 Bursts During Shaft Bottom and Main Development.**
- **Problems To be Solved**
  - **Pillar Size**
  - **Dynamic Roof Bolting System**

# COAL PILLAR SIZE

- Larger Pillar Size
- Smaller Pillar Size ---Burst free
- Smaller Pillar Size---Harmless Burst

# COAL PILLAR SIZE

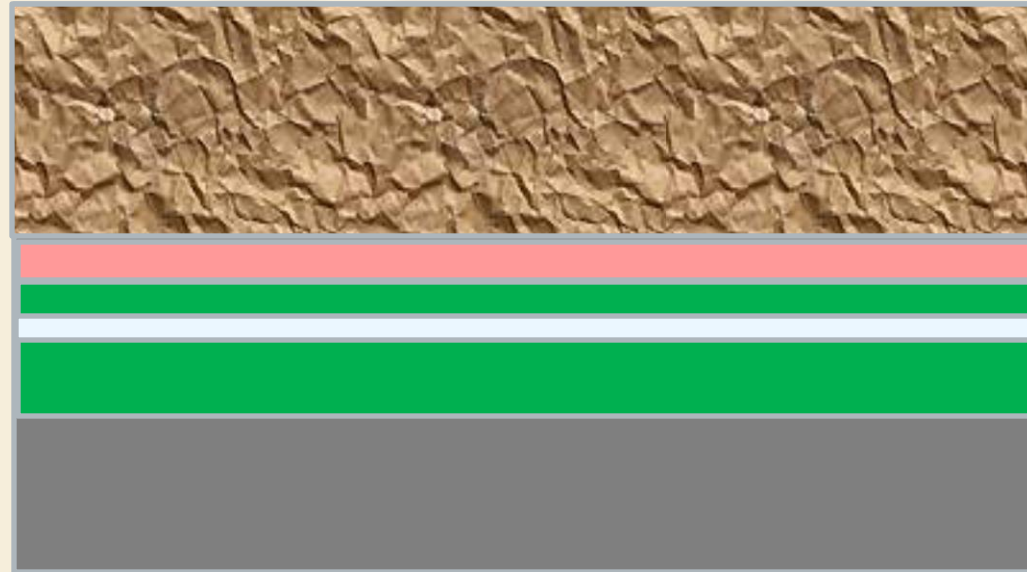
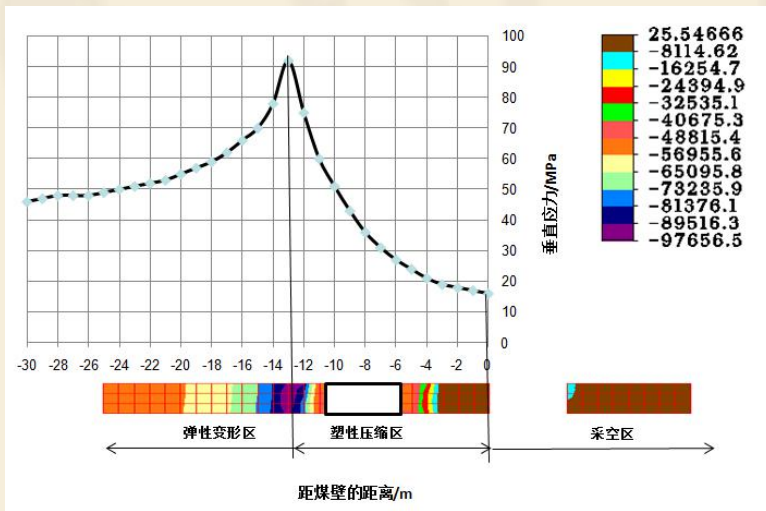
- **Larger Pillar Size**
  - Initiation Point Moves Further in by Face Line
  - Propagation Zone Some Distance in by Face Line
  - Burst Intensity Increases and Frequency Decrease
  - Large Enough to be Burst Free
  - Not Feasible to Mine Operation



# COAL PILLAR SIZE

## Smaller Pillar Size ---Burst free

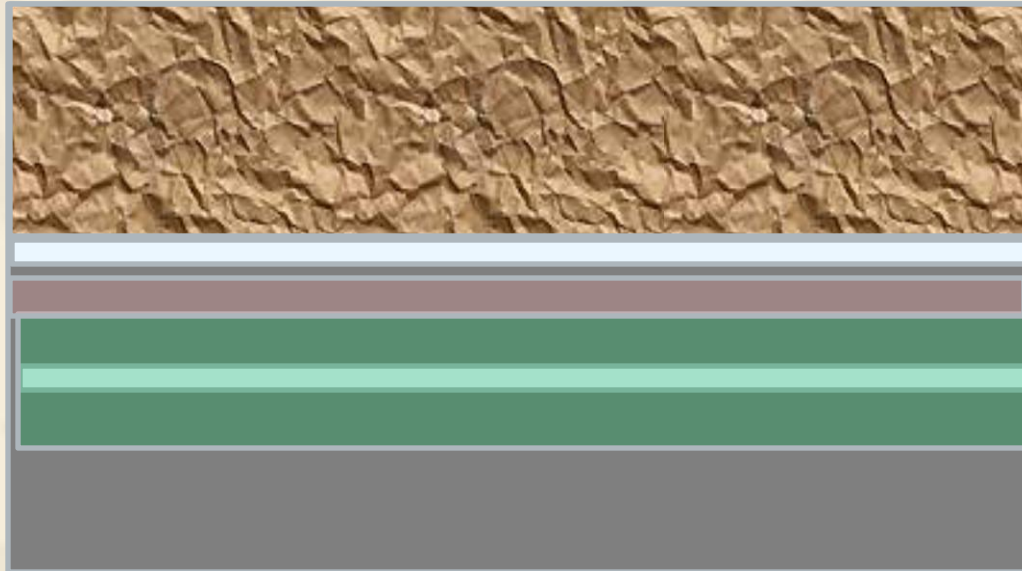
- First Longwall Retreating
- Tensile Fractured zone(1-2m)
- Compressive Fractured Zone(11m)
- Yield Zone(13m)
- Pillar Size and Tailge development
  - 5-8m
- Application





# COAL PILLAR SIZE

- **Smaller Pillar Size---Harmless Burst**

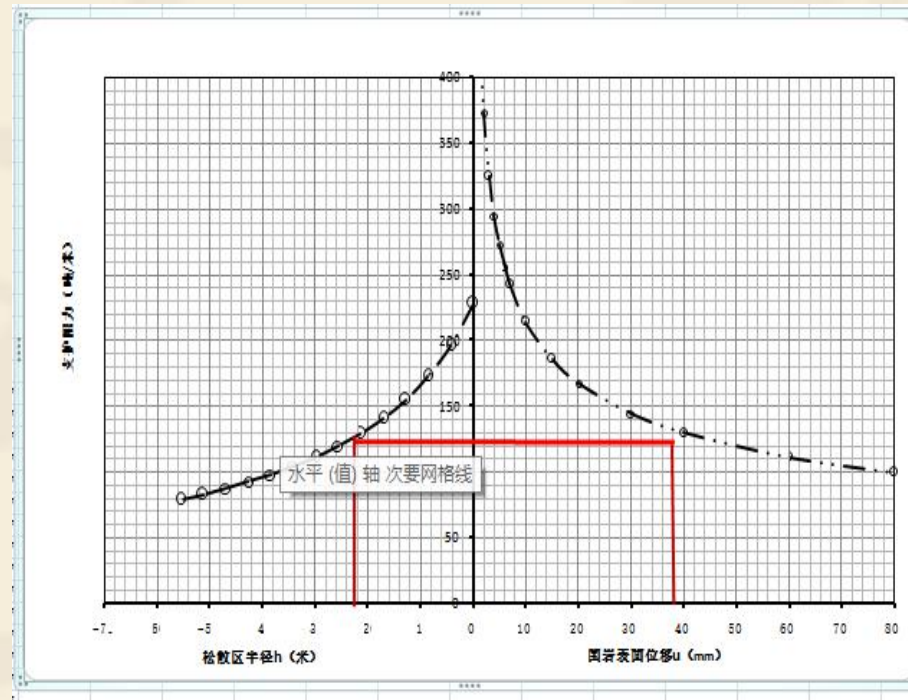


# FIVE-DIMENSIONAL WORKING POINT BOLTING DESIGN

- **Five Dimensions**
  - **Support Capacity**
  - **Displacement And Yieldable Bolt**
  - **Length of Bolt**
  - **Installed Load**
  - **Energy release and Absorption for Burst Conditions**

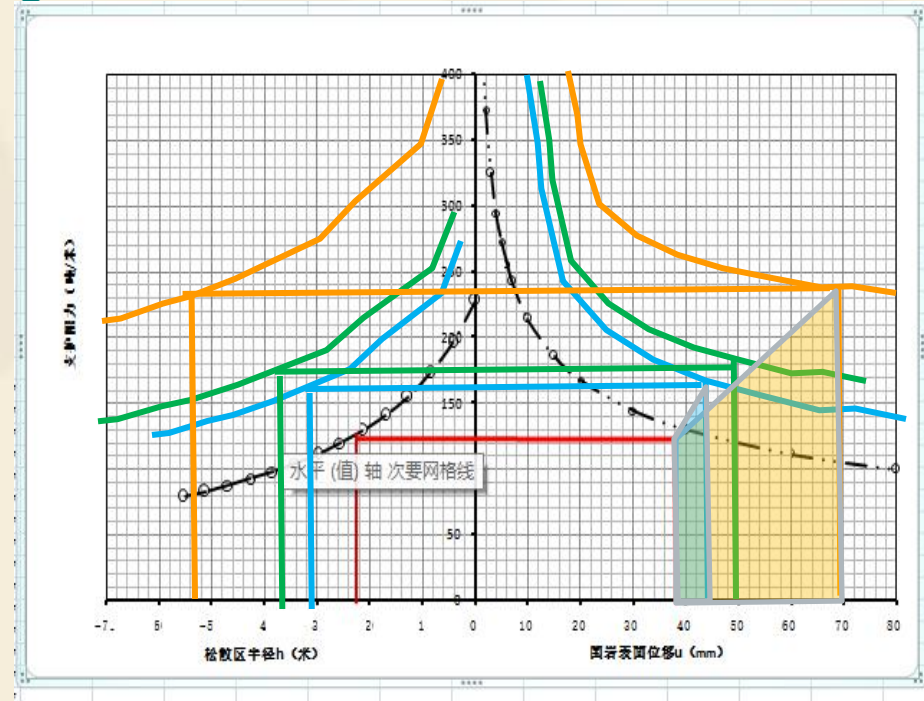
# FIVE-DIMENSIONAL WORKING POINT BOLTING DESIGN

- **Five Dimensions--Static**
  - **Support Capacity**
  - **Displacement And Yieldable Bolt**
  - **Length of Bolt**
  - **Installed Load**



# FIVE-DIMENSIONAL WORKING POINT BOLTING DESIGN

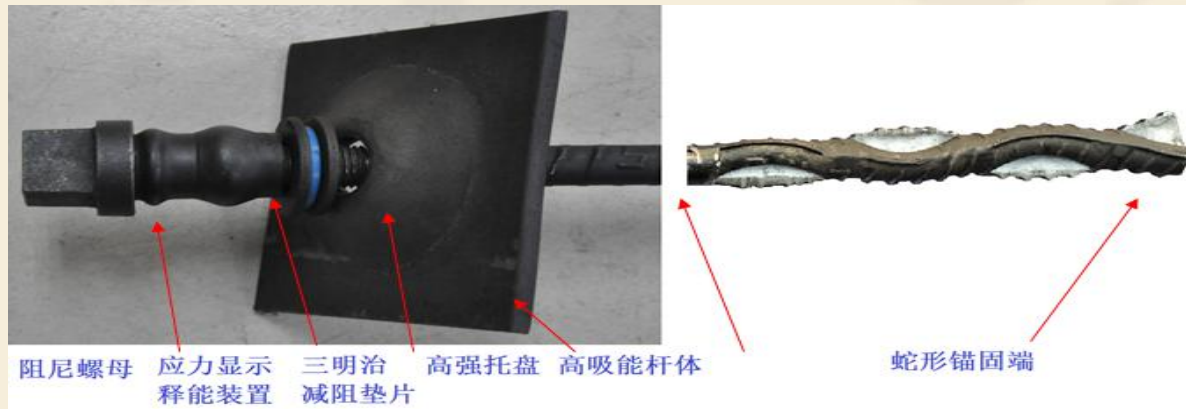
- Five Dimensions--Dynamic
  - Energy release and Absorption
    - Working Point Drifting
    - Energy Absorption
    - Energy Releasing





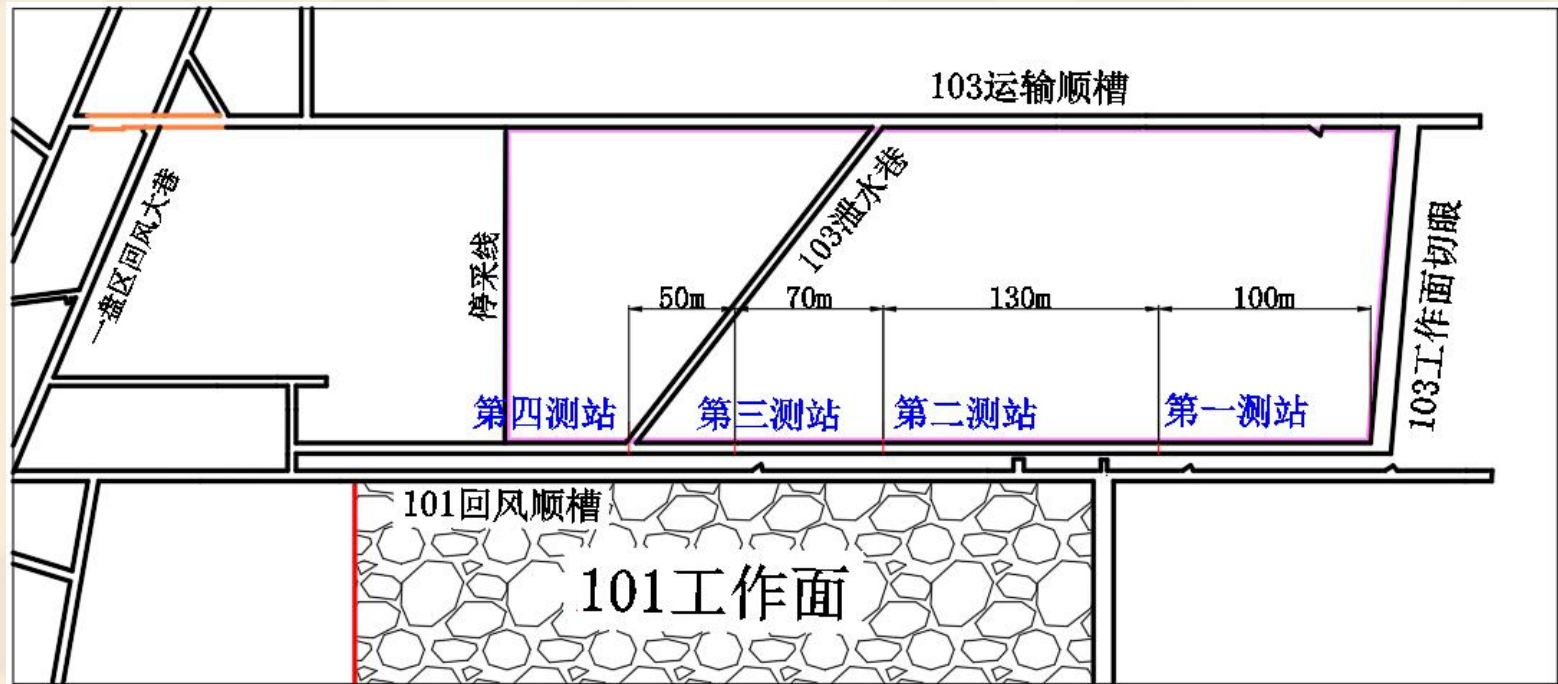
# PRODUCTS DEVELOPMENT

- **High Energy Absorption Steel Development**
  - Increase Impact Energy Index from 48J to 150J
- **Energy Release Parts Development**
- **Yield Tube**



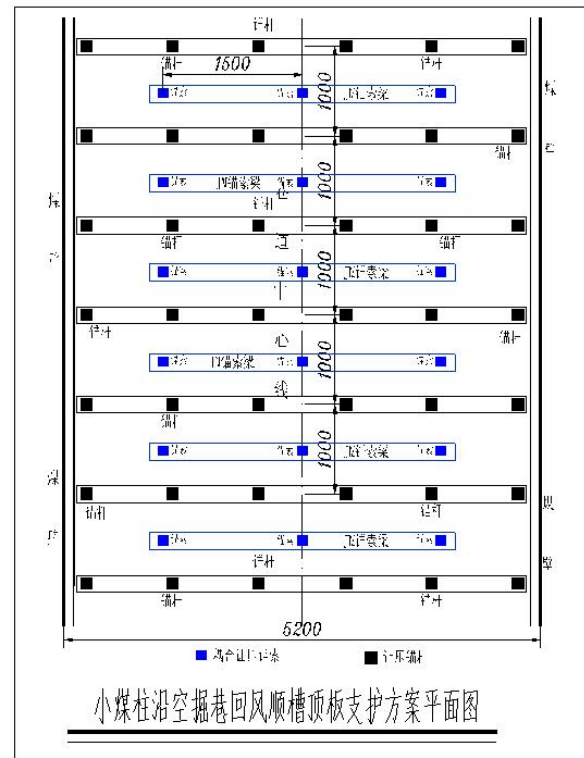
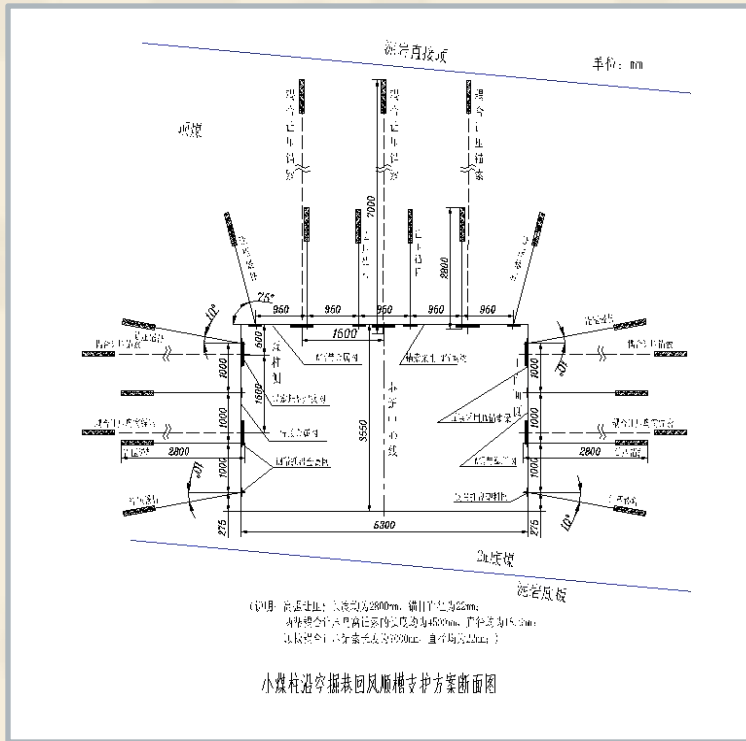
## APPLICATION CASES

- Application Cases



# APPLICATION CASES

- Application Cases



## APPLICATION CASES

- **Application Cases**
  - More than 10 tailgates in three mines have successfully supported.
  - Harmful Coal bursts have not happened during the tailgate development and longwall retreating
  - In some cases, although some small bumping, tailgate support absorbs and releases the dynamic energy.
  - Tailgate deformation is minimum, no maintenance team is required any more.