NARAYANI INSTITUTE OF ENGINEERING & TECHNOLOGY
ARAHAT, ANGUL

6th Semester, Mining Engineering

MNT – 604
Sub: - Mining Method (u/g metal)
Chapter – Rock Burst

Rock burst

Definition

Rock burst is considered as a dynamic instability phenomenon of surrounding rock mass of underground space in high geostatic stress and caused by the violent release of strain energy stored in rock mass.

Classification according to damage caused by seismic event

Author	Amount of damage				
Scott, 1990	Small seismic events		Large seismic events		
	bumps	knocks	strain burst	crush burst	
Scott et al., 1997	Microseismic events		Rockbursts		
			strain burst	crush burst	slip burst

Rock Bursts associated with stopes

Close proximity to excavations, result of the stress redistribution around the excavation.
Location highest Stress Point

1: Strain burst

• event of violent failure where small pieces of rock are ejected from the boundary of excavation
• relatively limited damage, amount of energy released is small.

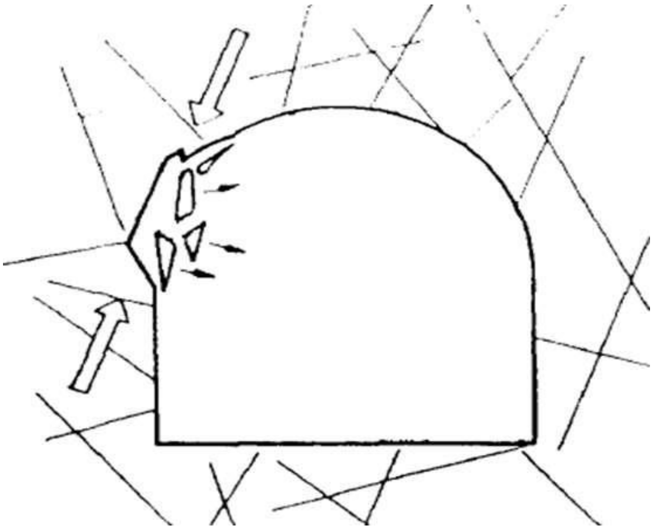

Fig: Strain bursts

2: Pillar burst

• Pillar burst is violent failure of pillar, and is also a result of local stress redistribution.
• Severe Damage depends on location and the state of surrounding pillars and rock.
• larger amount of energy is released.
• Sudden stress redistribution to nearby pillars, which may fail violently.
• A domino effect of pillar failures may result.

3: Face Burst

• Its a form of strain burst caused by the accumulation of strain energy.

• Violent ejection of material from the face into the excavated area.

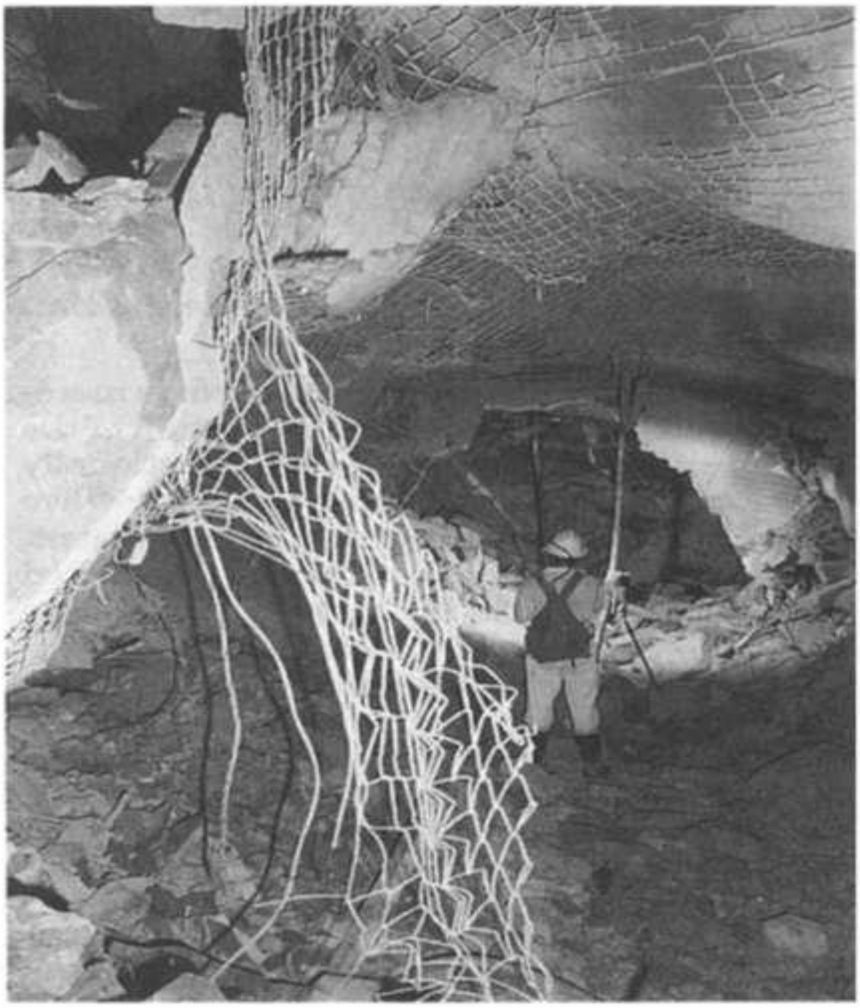

Fig: Face crush in 3.5 m x 3.5 m tunnel at a depth of 3100 m, after seismic event ofl.8 M L located about 40 m away.

Rock Bursts associated with geologic discontinuities

Stress redistribution from larger scale mining can lead to reactivation of faults in the area or violent formation of new fractures through intact rock.

• The most common type of large-scale seismic event is fault slip.

• The damage caused by these events can be very severe.

• They can affect a large area and even be felt on the surface.

1: Fault slip

Mining activity reduces shear resistance along the fault and increases shear force along the fault, so that slip occurs.

• Ejection of blocks defined by existing joints.

• A tensile stress close to the boundary of the opening which results in a tensile failure.

• A large compressional stress, which results in a failure that can be followed by ejection of rock.

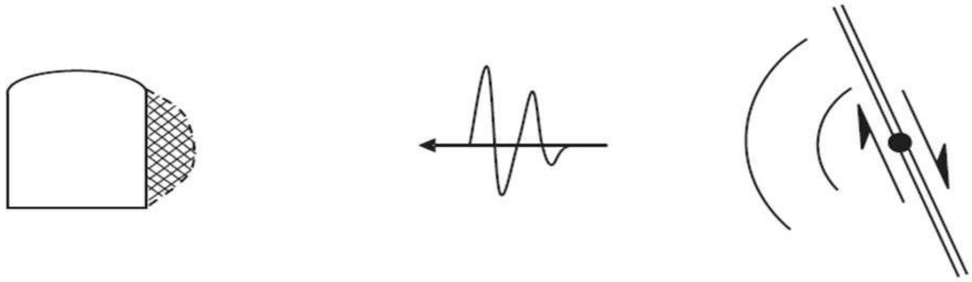

Fig: Fault-slip rock burst event.

Fig: A fault-slip rock burst in a deep metal mine (Simser, 2001).

<u>2: Shear rupture</u>
• Shear rupture is a shear failure through intact rock
• Radiation of seismic waves causes damage
• It occurs when the compressive stresses exceed the shear strength of the rock.
• Another requirement is that the rock mass has to be free of joints.
• The damage type is the same as for a fault slip event.

<u>Damage Mechanisms</u>

<u>1: Strain Bursts</u>
• Strain bursts are the most common damage mechanisms.
• Mechanism is buckling of the thin diaphragm, slab, or column rock.
• Sharp edges and violence of ejection represent a safety hazard.
• strain bursting conditions can cause significant cutting problems.
• Strain bursting conditions decrease in tunnel-ling progress rates.

2: Buckling

- most likely to occur in laminated or transversely anisotropic rock.
- Damage occur anywhere around the periphery of the opening.
- The energy source is strain energy stored in the "plates" subject to potential buckling.
- Additional energy input may come from seismic waves.
- Sudden release of the locally stored strain energy.
- Locations of source and the damage mechanism will be coincident.

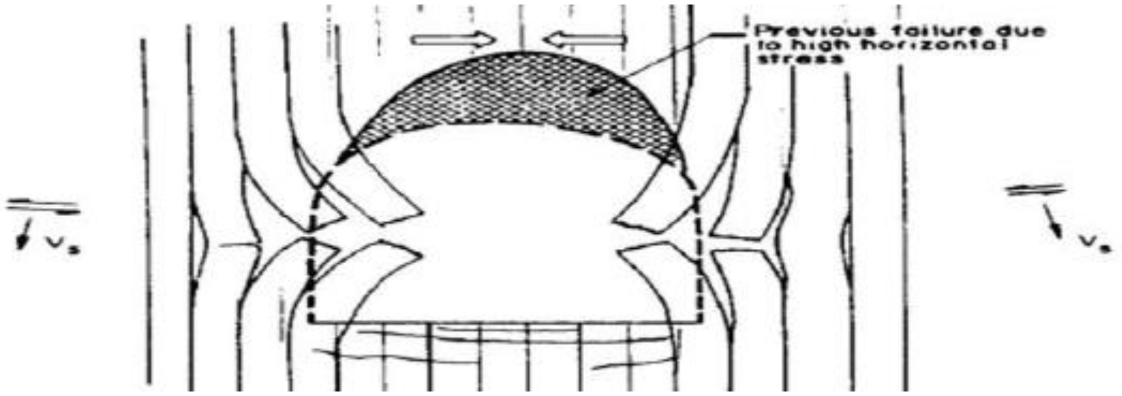

Fig:5 buckling of plates of laminated or transversely anisotropic rock, buckling burst.

3: Ejection

- Ejection of a portion of the wall (floor or roof) b/c of shock wave).
- The source of energy is a seismic event.
- The source and damage locations are not coincident.
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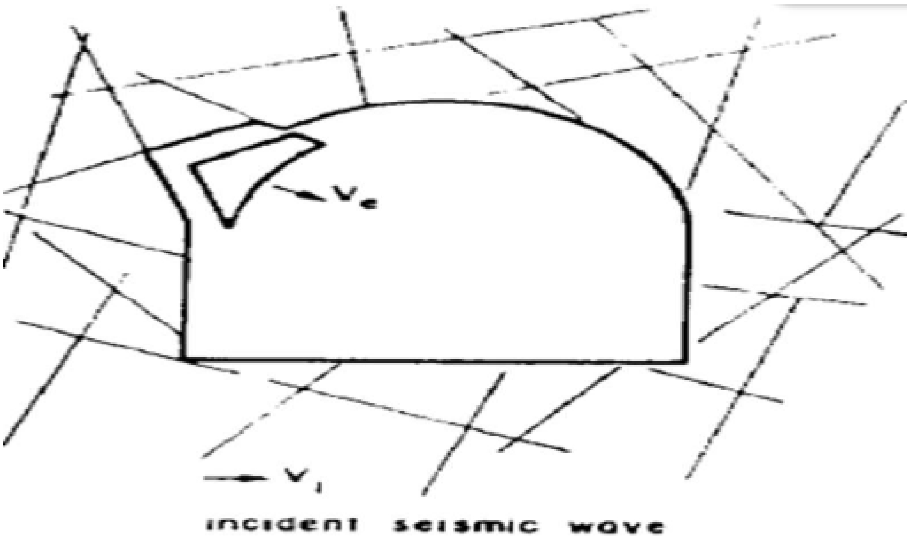

Fig: An ejection-type rock burst results from expulsion of joint or fracture-defined block of rock.

4: Arch collapse

- Arch collapse is a sub-set of the ejection mechanism.
- The well-defined geological structure or induced fracturing, or a combination of the two induce it.
- Movement of large wedges with gravity is main driving force.
- The seismic wave energy provides additional acceleration which overcomes the shear strength on the well-defined surfaces.
- As result rock bolts that have been "guillotined" by the movement of the wedges.

Fig: Collapse of roof arch of haulage in quartzite at depth of 2700 m after seismic effect of 2.1 M L

Classification of rock burst intensity

Classification of rock burst intensity is different for each scholar. So it is difficult to use these criteria in construction of underground engineering. Classification by Hou;

Item	No rock burst	Light rock burst	Medium rock burst	Violent rock burst
W_{qr}	<1.5	$\leqslant 2.5$	$\leqslant 3.5$	>3.5
σ_1	$<\sigma_c/\sqrt{\alpha W_{qr}}$	$\leqslant 1.41\,\sigma_c/\sqrt{\alpha W_{qr}}$	$\leqslant 1.73\,\sigma_c/\sqrt{\alpha W_{qr}}$	$>1.73\,\sigma_c/\sqrt{\alpha W_{qr}}$

Where Wqx is the rock burst tendency index, σ1 is the major principal stress in surrounding rock

PREVENTION AND CONTROL OF ROCKBURST

- The cause of rock burst is (in many cases) a combination of stiffness of rock and stresses high enough to exceed the strength of the rock.
- The potential of violent failure is also higher in homogenous rock, i.e., rock with less natural discontinuities or with little variation in mineralogy.

To Control Rock burst or Prevention need;

- Decrease in rock stiffness.
- Greater energy dissipation in rock.
- Changing layout of excavation to decrease the stresses.
- Changing Shape of Opening.