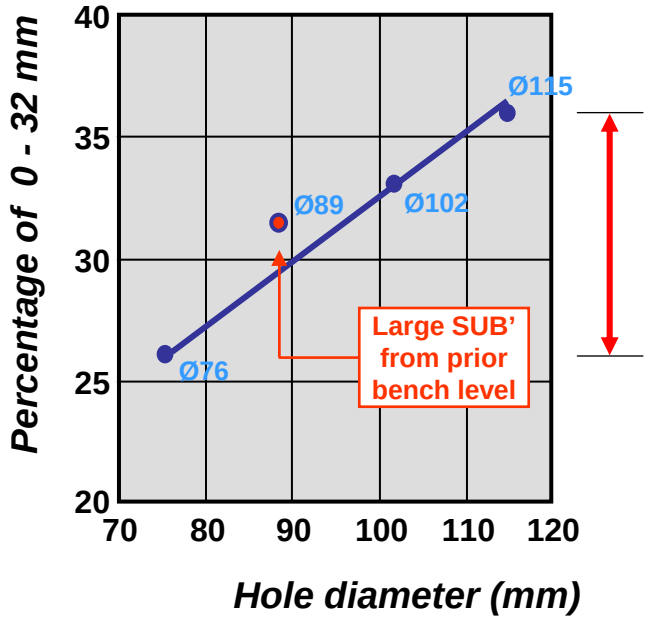
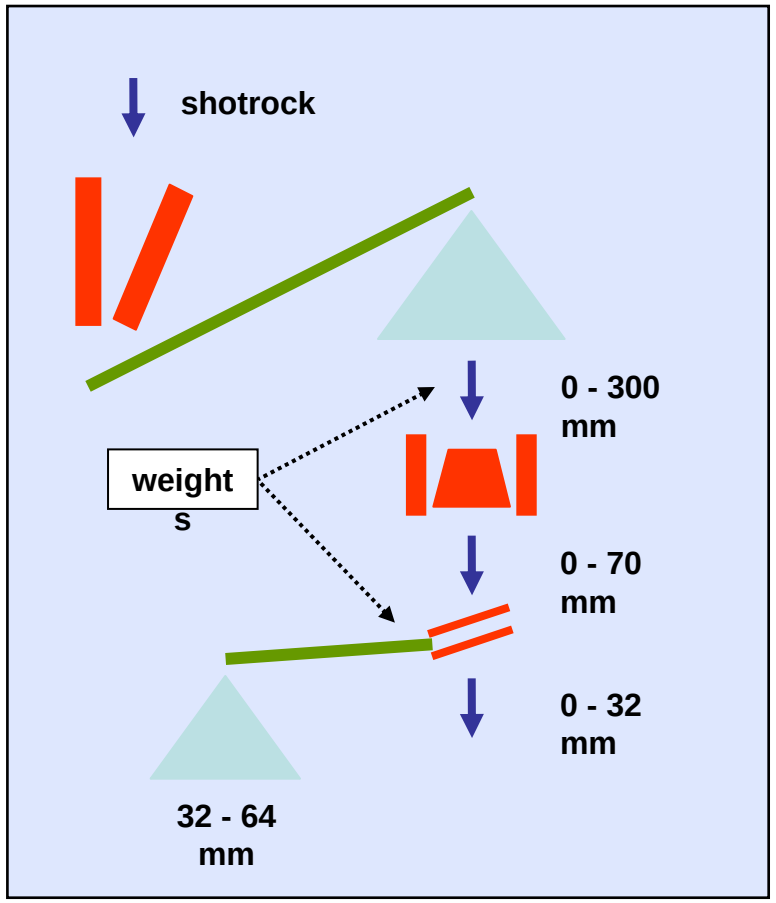
Fines Management

Nodest Vei A/S, Norway - effect of shotrock micro-fracturing

Rock type	*Anorthosite*
Explosive	*Slurrit 50-10*
Test blasts	*4 x 50 000 tonnes*
Bench height	*11 m*

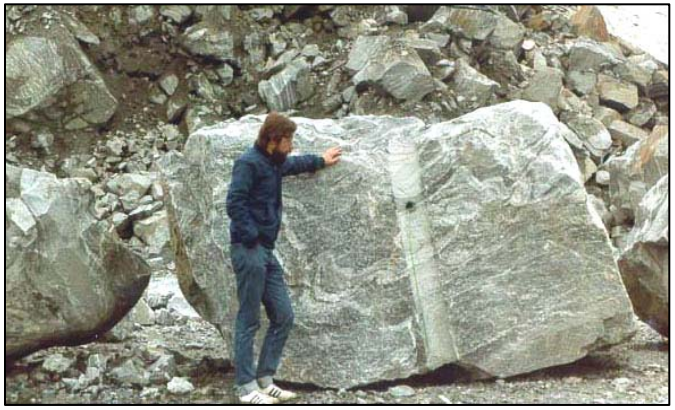




Boulder Management

Boulder handling

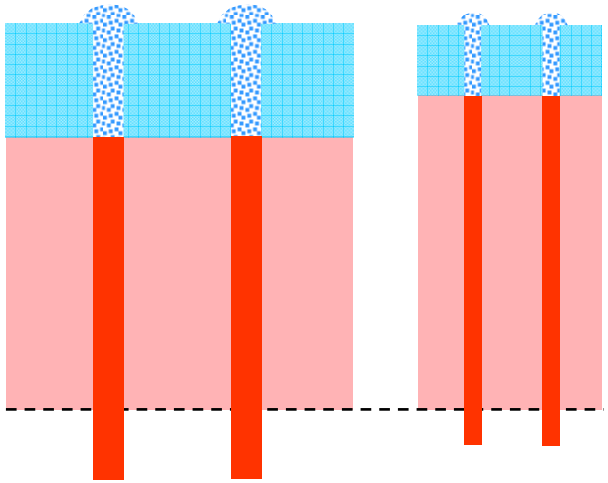
- *boulder count dependent on primary crusher opening (and to a lesser extent capacity)*
- *sort boulders from muck pile*
- *down-size boulders*
- *minimize boulder count using reduced uncharged height and/or tighter drill patterns*

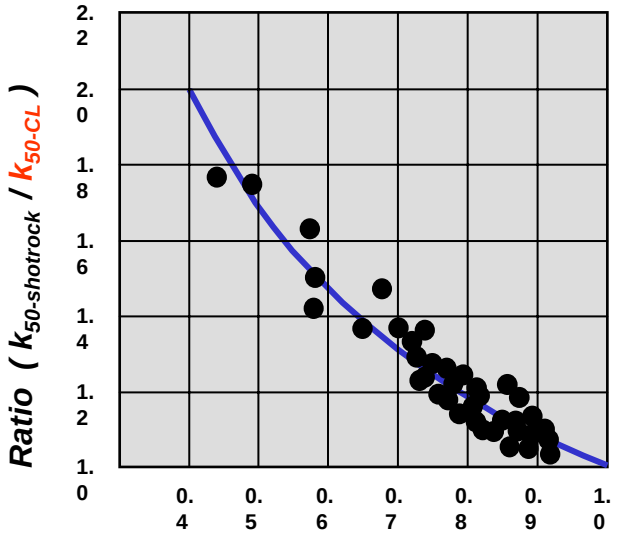


Boulder Management

Shotrock boulder count versus charged portion of blast

Boulders originate from the uncharged portion of a bench blast. To reduce shotrock boulder count and size; the uncharged portion of the blast must be reduced, and if necessary, by using smaller shotholes - which dictate smaller drill patterns, less stemming and sub-drill.



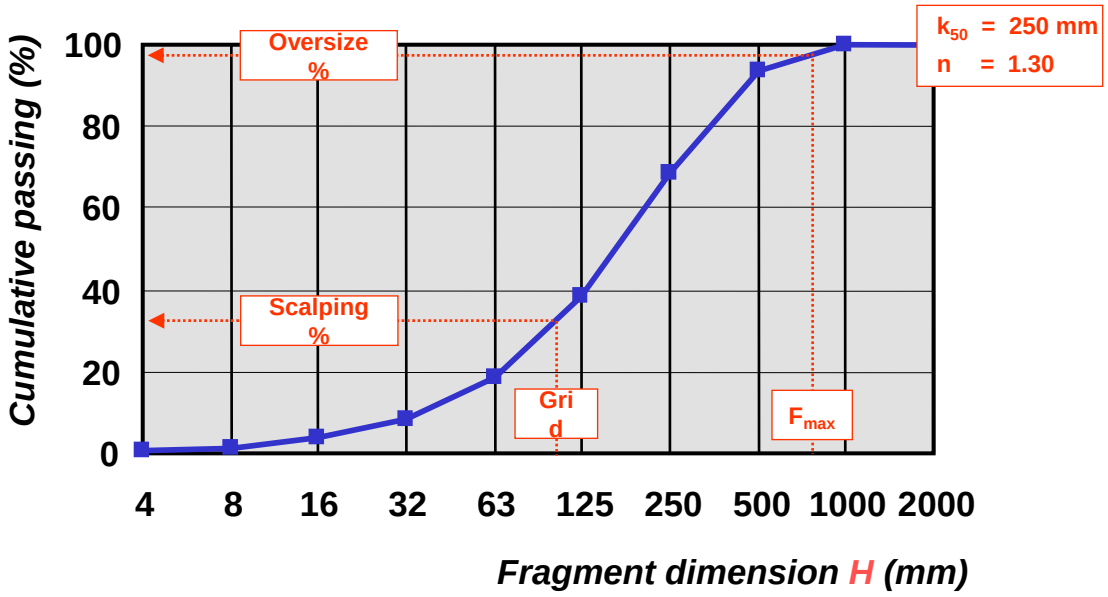


$$k_{50\text{-shotrock}} = k_{50\text{-CL}} / f_{CL}^{0.76}$$

Boulder Management

Primary crushing - gross capacity components

- *crusher size* - *design capacity versus feed fragment sizing*
- *scalping* - *scalping capacity increases with grid opening*
- *occurrence of boulder bridging, blockages and delays*
- *occurrence of no shotrock delivery* **versus** *use of pre-primary surge pile*
- *downtime for maintenance and replacement of wear parts*

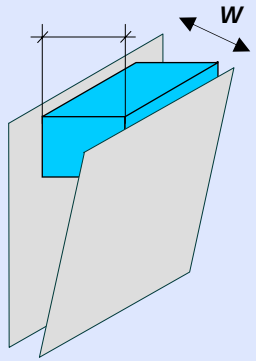


Boulder Management

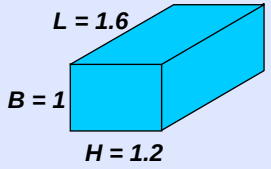
Matching boulder size to primary crusher opening

Primary crusher feed, 0 - F_{max}

F_{max} = H_{max} ~ 0.8 x W



Typical boulder dimension ratios



Boulder Management

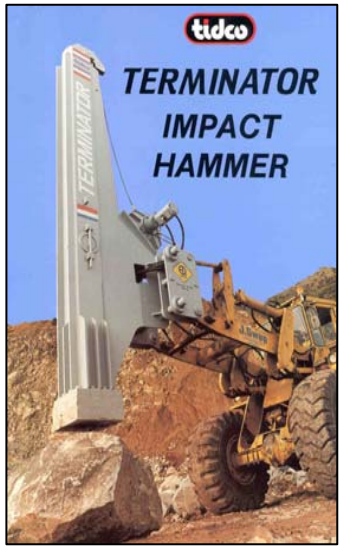
Example of application using shotrock fragment size distribution

Primary crusher opening	W	= 950 mm	
Crusher limit as to boulder height	H_{max}	= 950 · 0.8	= 760 mm
Crusher limit as to boulder length	L_{max}	= 760 · 1.6 / 1.2	= 1013 mm
Crusher limit as to boulder thickness	B_{max}	= 760 · 1.0 / 1.2	= 633 mm
Shotrock size distribution parameters	k_{50}	= 250 mm	
	n	= 1.30	
Shotrock oversize percentage	$P(1013)$	$= 100 \cdot e^{-\ln 2 \cdot (1013 / 250)^{1.30}}$	
		= 1.39 %	
Blast volume	10 000 bm^3		
Shotrock boulder (oversize) count	N	≤ 10 000 · 0.0139 / (1.013 · 0.760 · 0.633)	
		≤ 286 boulders / 10 000 bm^3	

Boulder Management

Methods for down-sizing boulders

- ***hammering with breakers mounted on:***
  - *hydraulic excavators working along the loading front*
  - *hydraulic excavators working at boulder stockpiles*
  - *stationary booms located at primary crushers or grizzlies*
- ***drop-weights or swing-balls***
- ***secondary blasting***



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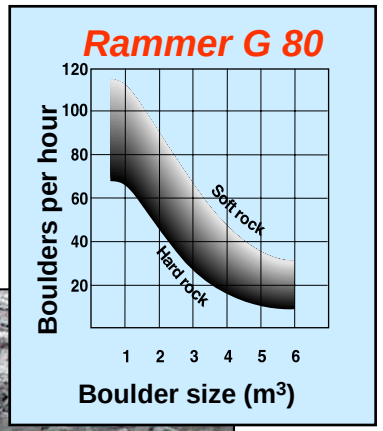
Boulder Management

Typical inpit usage of hydraulic excavator mounted breakers

- *down-sizing boulders*
- *removing floor humps*
- *scaling and cleaning back walls*
- *breaking up frozen sub-drill zones prior to removal*



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