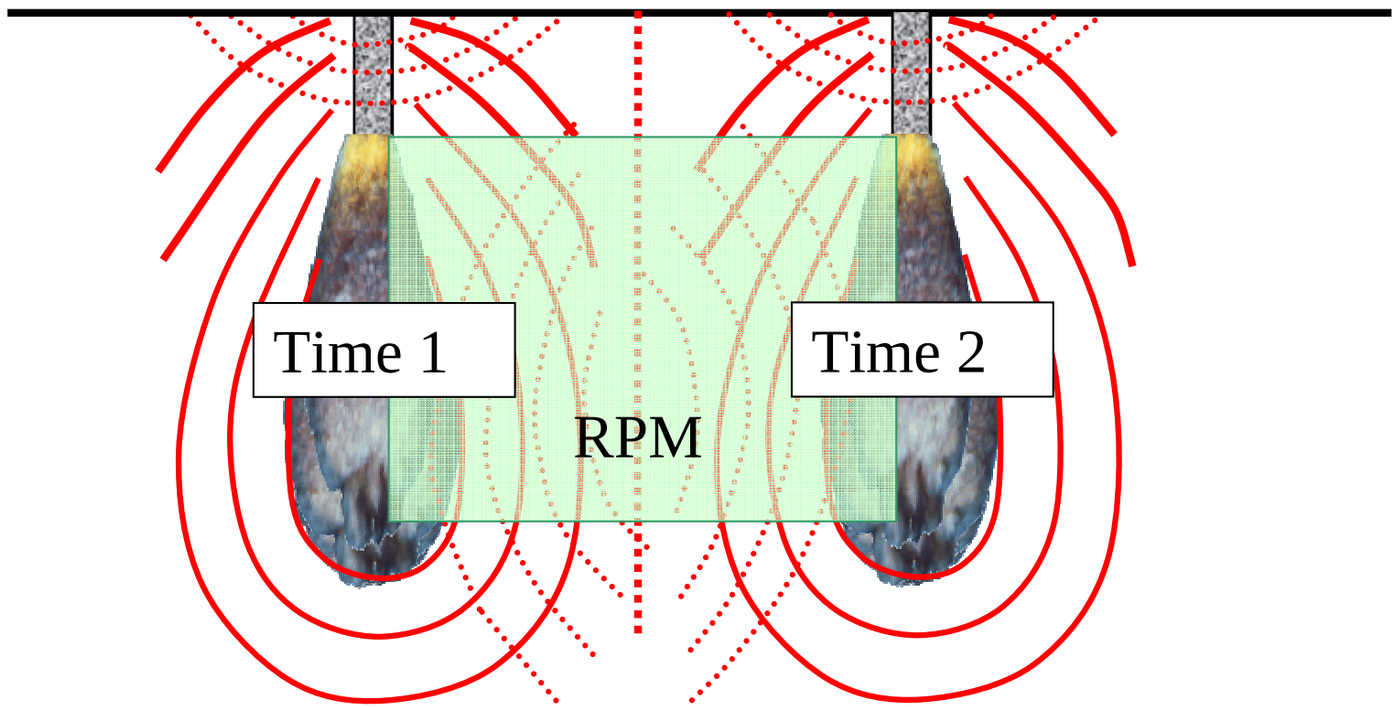
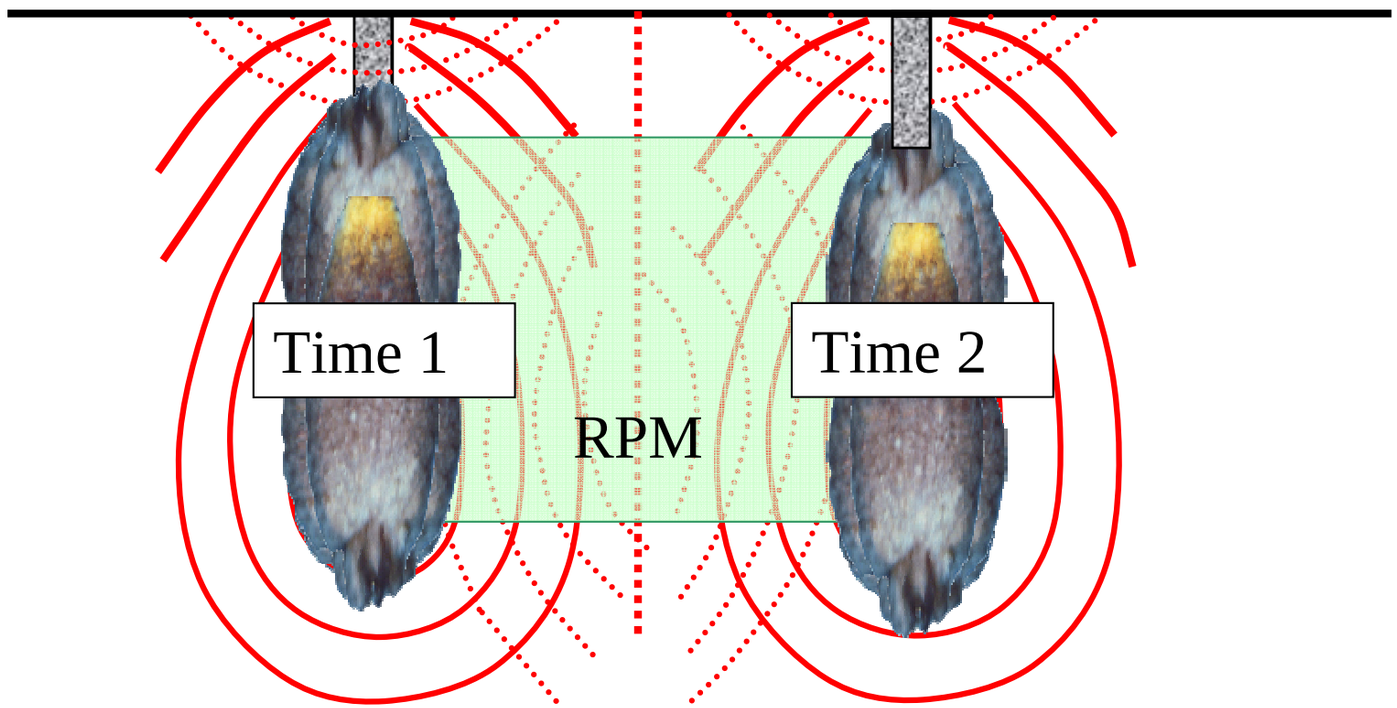
Chemical Crusher (conceptually)



QUARRY ACADEMY

Chemical Crusher (conceptually)



QUARRY ACADEMY

Chemical Crusher - Key Design Factors

Exactly Right Energy

Exactly Right Place
Exactly Right Time

Exactly Right Place

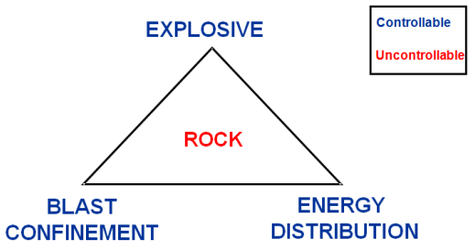
Controllable

Uncontrollable

QUARRY ACADEMY

Explosive

A controllable factor in building the Chemical Crusher

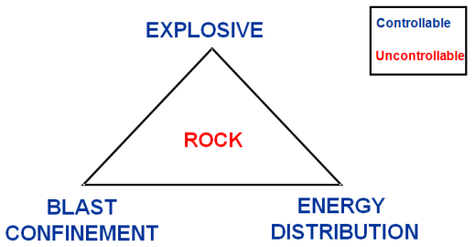


- The energy, pressure and after blast fumes generated by an explosive detonation are determined by the explosives:
  - Composition
  - Density (g/cc)
  - Diameter
  - Velocity of Detonation (ft/sec)
- Commercial explosives are available in both:
  - Packaged
  - Bulk
    - Dry Blend / Free Flowing
    - Wet Blend / Augerable
    - Pumpable Blend

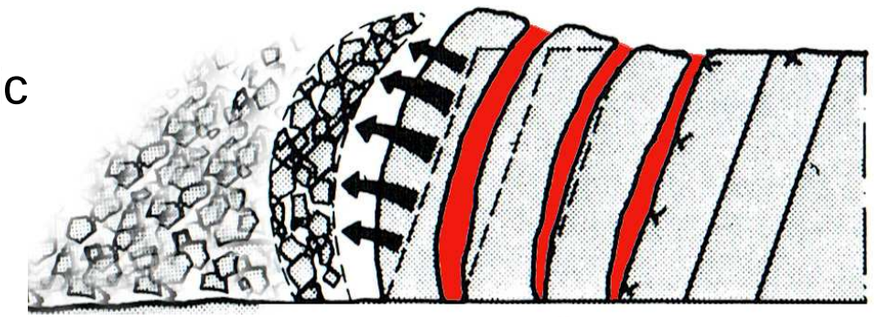
QUARRY ACADEMY

Blast Confinement

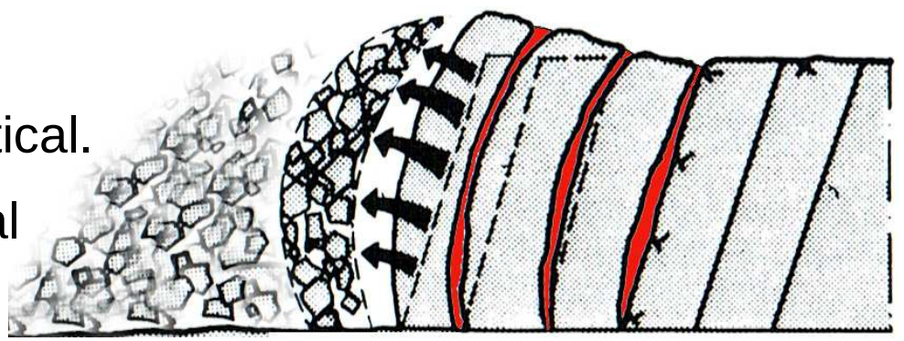
A controllable factor in building the Chemical Crusher



- Confinement determines the amount of the explosive's energy that does effective work. Confinement is provided by:
  - Material surrounding the explosive in the drill hole.
  - The amount of material between the drill hole and any static or dynamic open space or what we call the burden.
  - **Burden is a critical blast dimension. All blast design parameters are based on burden.**
  - The distance between drill holes (Spacing) relative to one another in a row.
  - Stemming / non explosive decking. Size and quality is critical.
  - Initiation sequence and time between and within individual blast holes.



Less Confinement

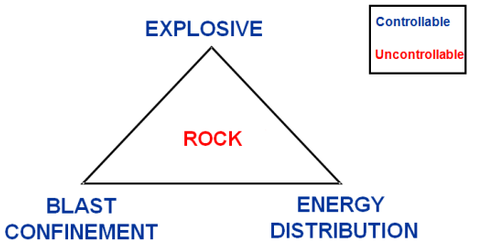


More Confinement

QUARRY ACADEMY

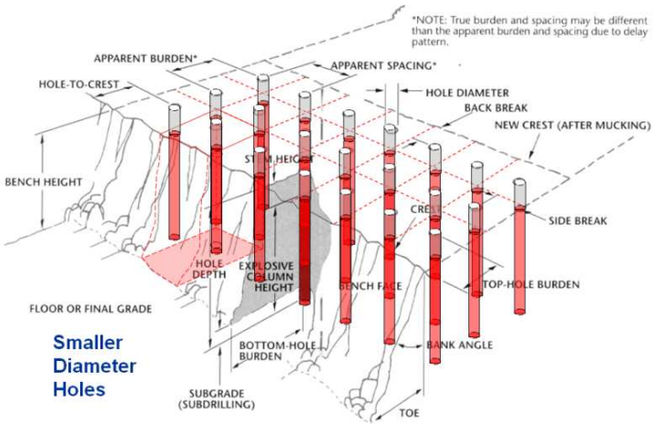
Energy Distribution

A controllable factor in building the Chemical Crusher

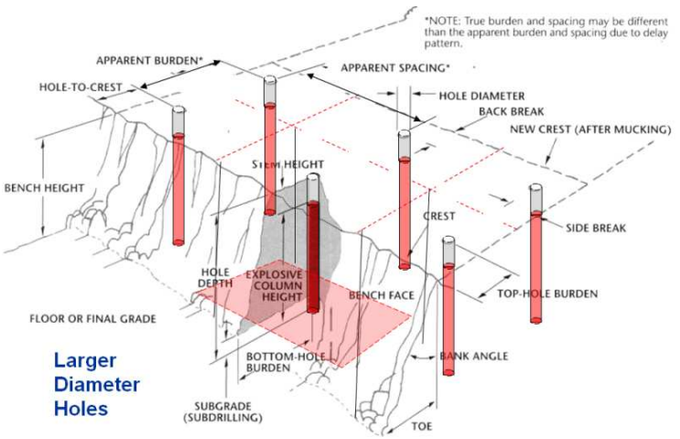


- How the explosive energy is distributed throughout the rock mass to be blasted – vertically and horizontally to do work. Energy Distribution is controlled by:
  - Diameter of the drill hole.

Energy Distribution is the Critical to controlling rock fragment size during the blasting process

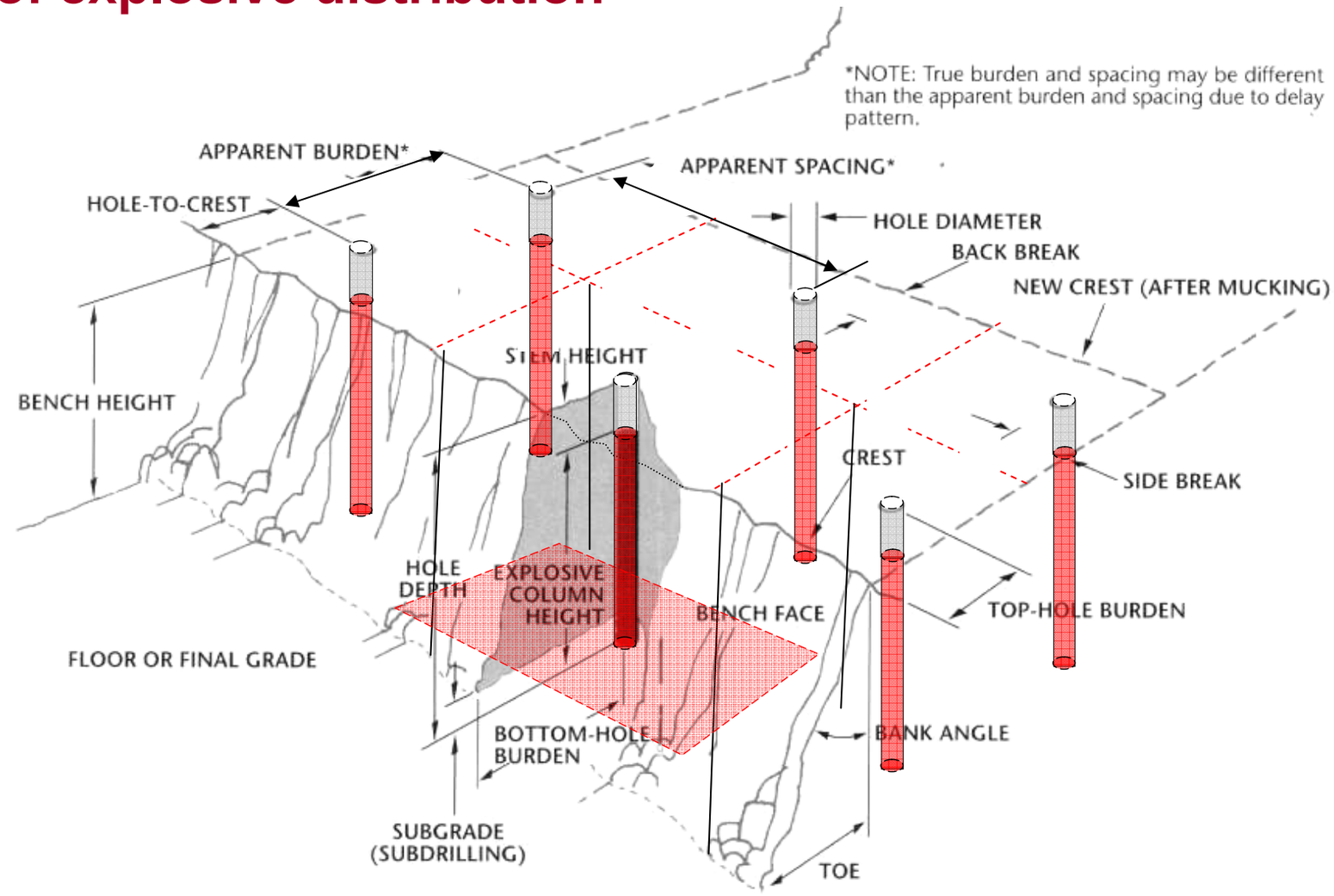


- **Single column of explosive – Amount loaded with explosive versus amount filled with stemming.**
  - ✓ **Multiple separated columns of explosive – the amount loaded with explosive and the amount filled with stemming and their relative positioning throughout the rock mass**
  - Orientation of drill holes
    - ✓ **Relative to one another – staggered, in-line**



QUARRY ACADEMY

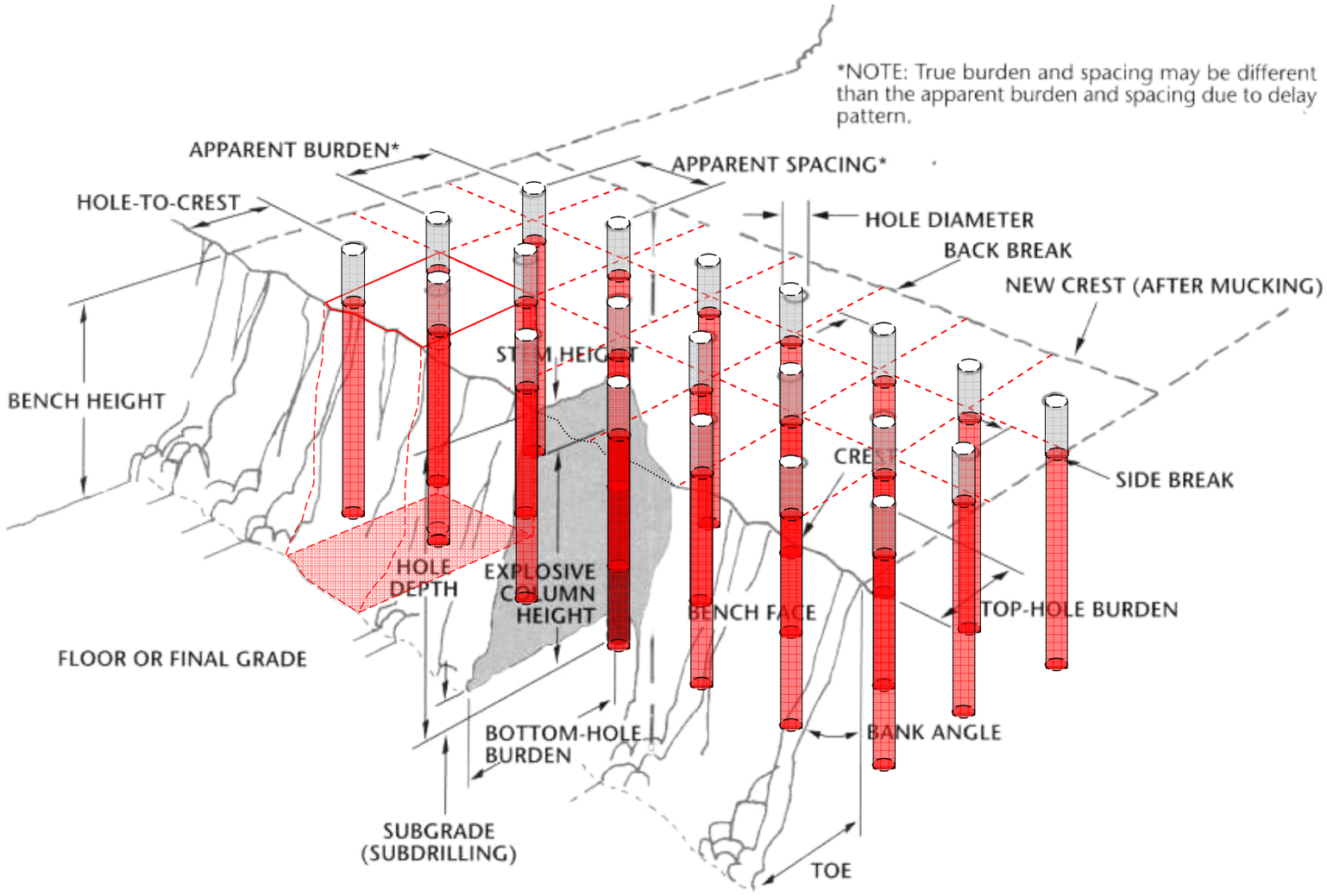
Building the Chemical Crusher
Static view of explosive distribution



QUARRY ACADEMY

Larger Diameter Holes

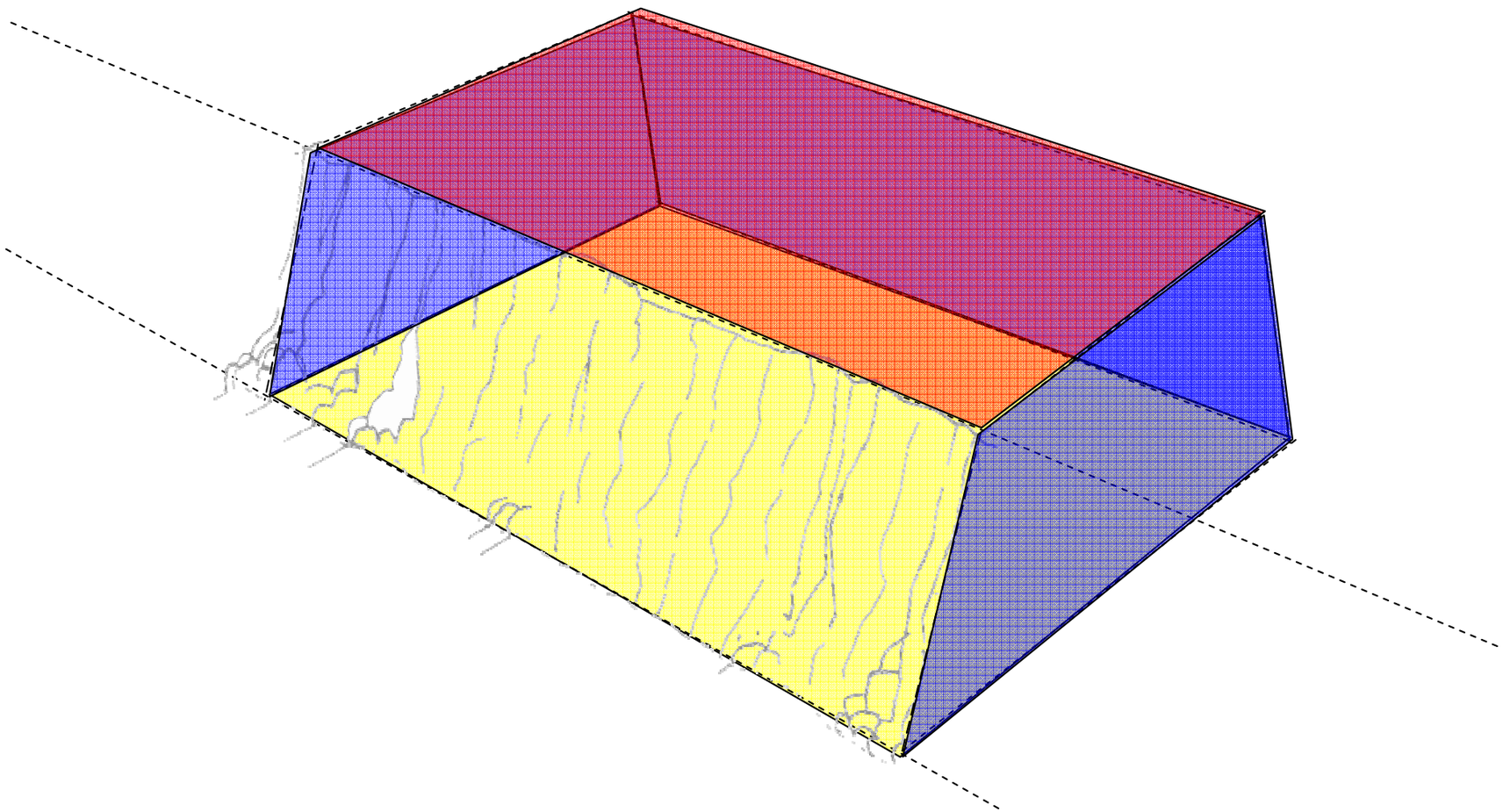
Building the Chemical Crusher
Static view of explosive distribution



QUARRY ACADEMY

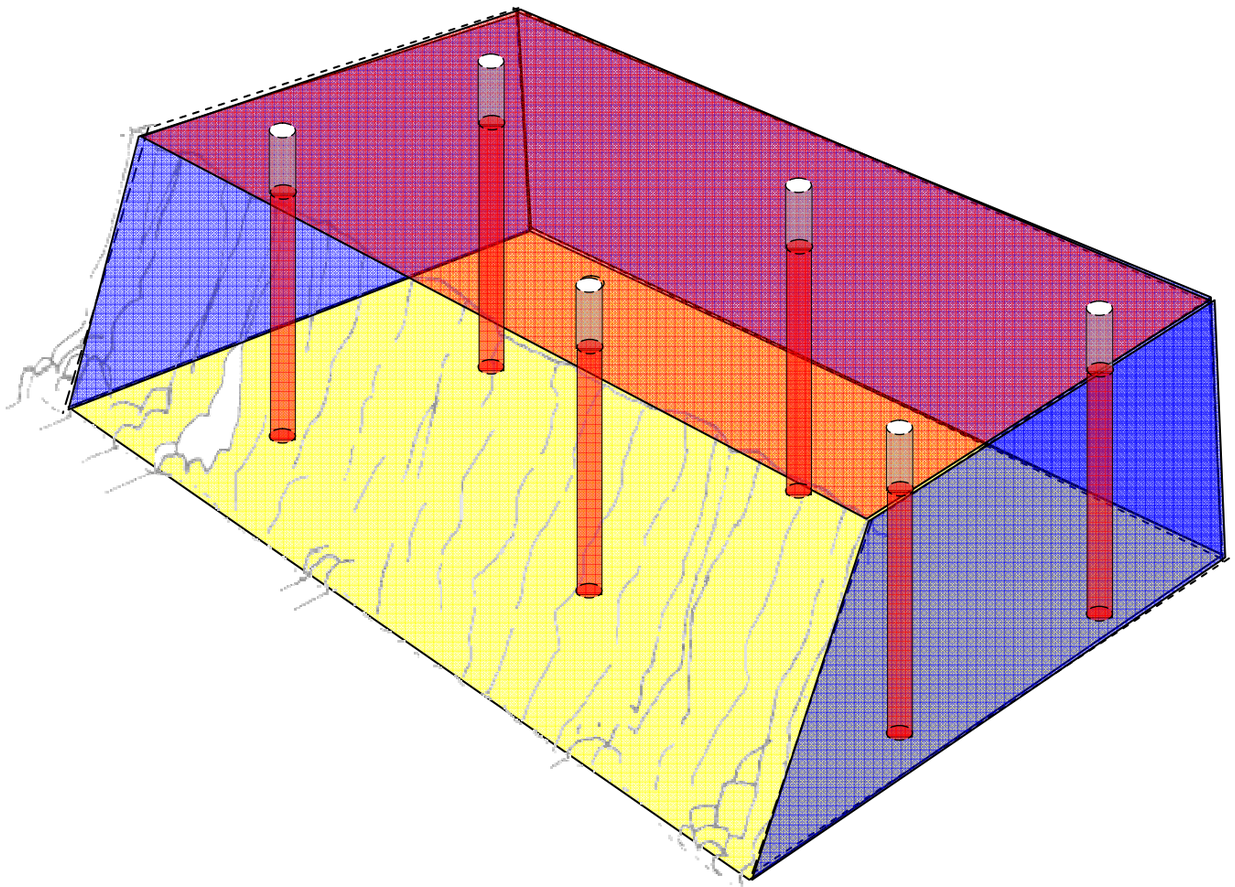
Smaller Diameter Holes

Target Work Zone for Chemical Crusher



QUARRY ACADEMY

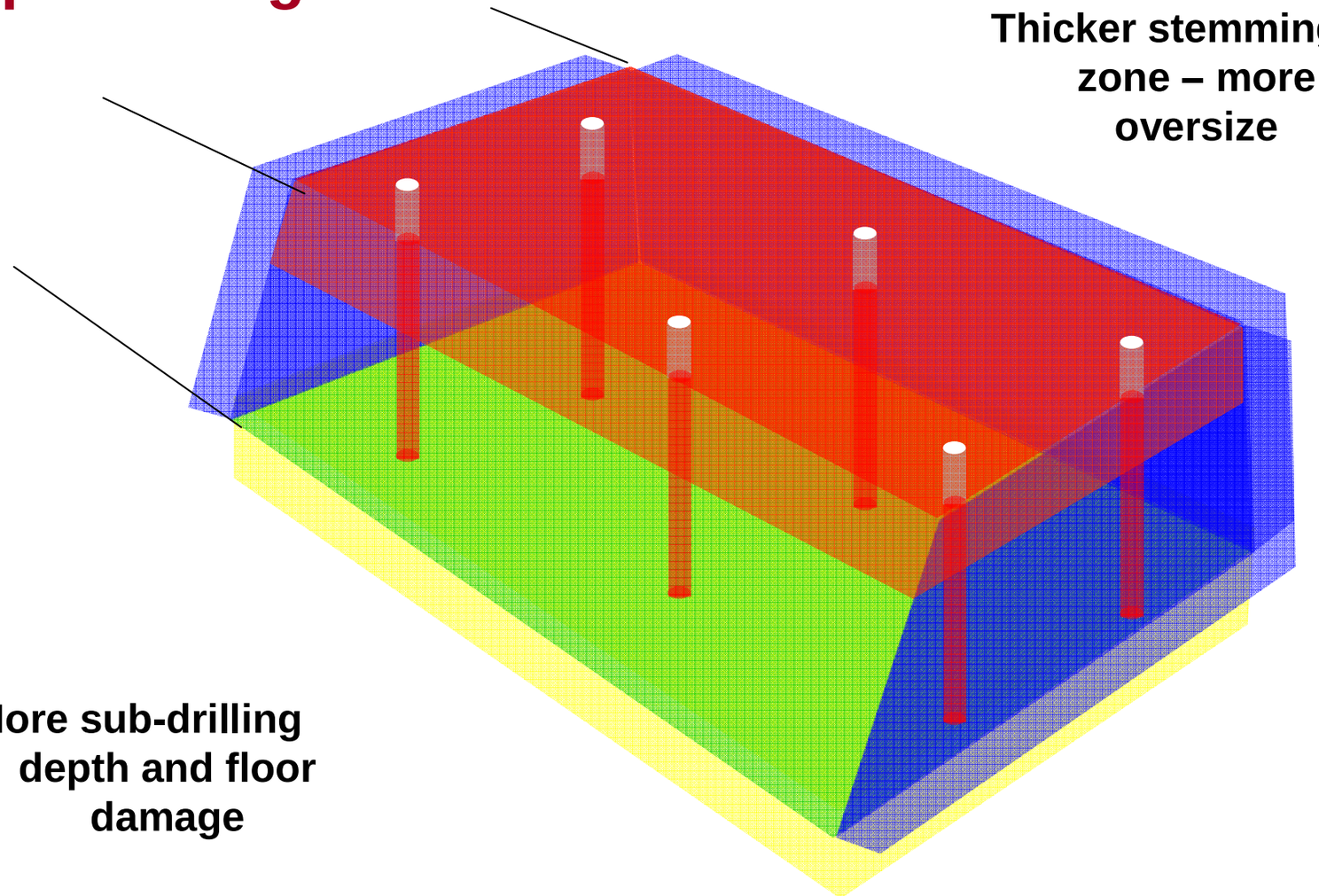
Larger diameter holes in Target Work Zone



QUARRY ACADEMY

Larger diameter holes allow for smaller overall percentage of crushed rock

Thicker stemming zone – more oversize

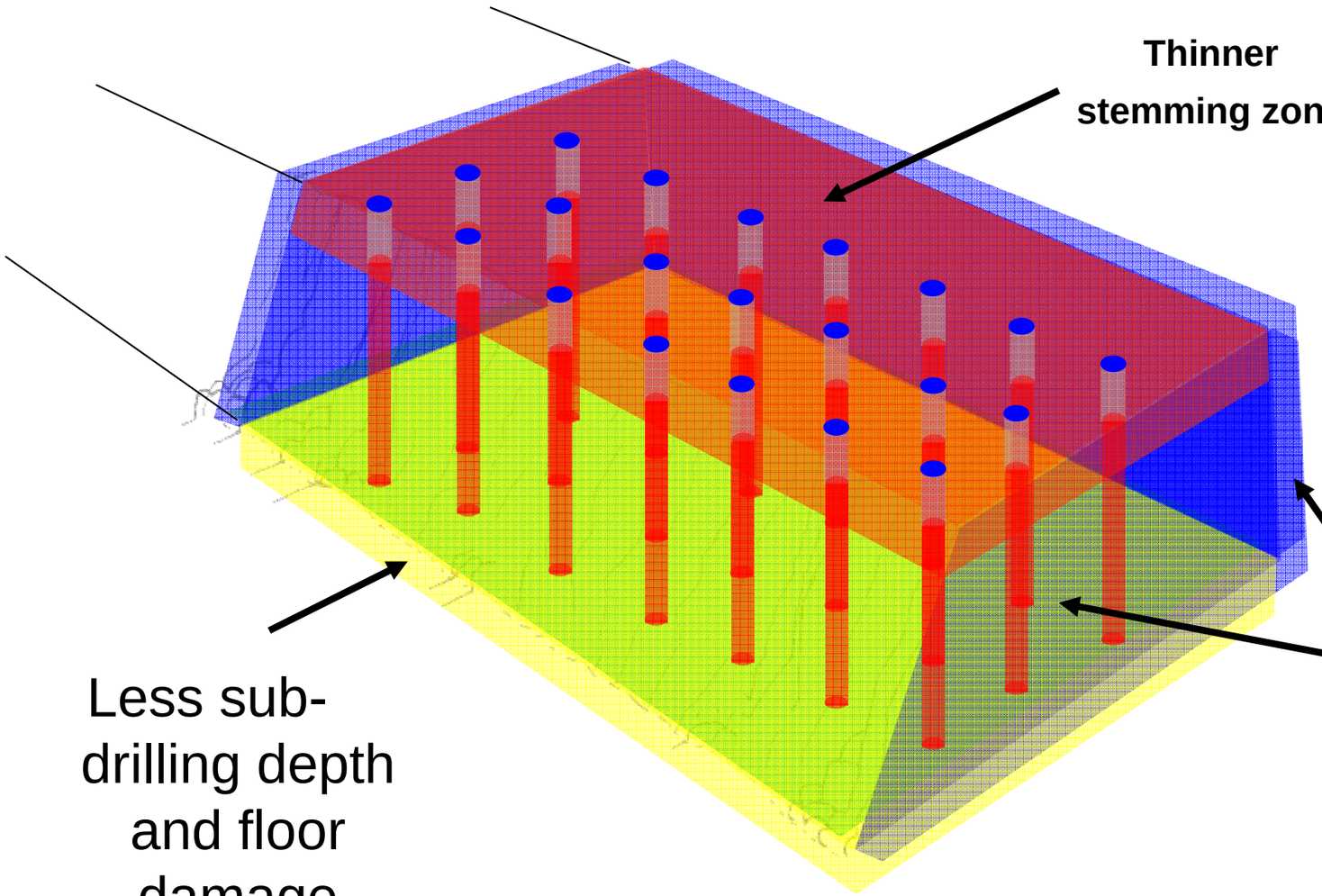


More wall damage

More sub-drilling depth and floor damage

QUARRY ACADEMY

Smaller diameter holes allow for higher overall percentage of crushed rock



QUARRY ACADEMY

Uniform Gradation - Coarse


Uniform Gradation - Fine

Prior examples come from the same shot!

Program designed shot using electronic detonators

Drill Hole not charged

Chemical Crushing

“Rubblization”

Fragmentation dictated by geology

The Chemical Crusher: Drilling & Blasting

Exactly Right Energy

Exactly Right Place

Exactly Right Time

QUARRY ACADEMY

Conclusions

- Chemical Crusher can relieve work done by the primary crusher and improve its efficiency.
- As is the case with a mechanical crusher, tight tolerances and high quality are a necessity when building the Chemical Crusher.
- Implementing drill and blast programs based on the chemical crusher approach, can yield quarry process stream cost savings that are better measured in dollars per ton than in cents per ton.

www.quarryacademy.com

Improving Processes. Instilling Expertise.

DYNO
Dyno Nobel

SANDVIK