# RULES AND CALCULATIONS OF ROCK EXPLOSIVE ENGINEERING

## Lecture 2

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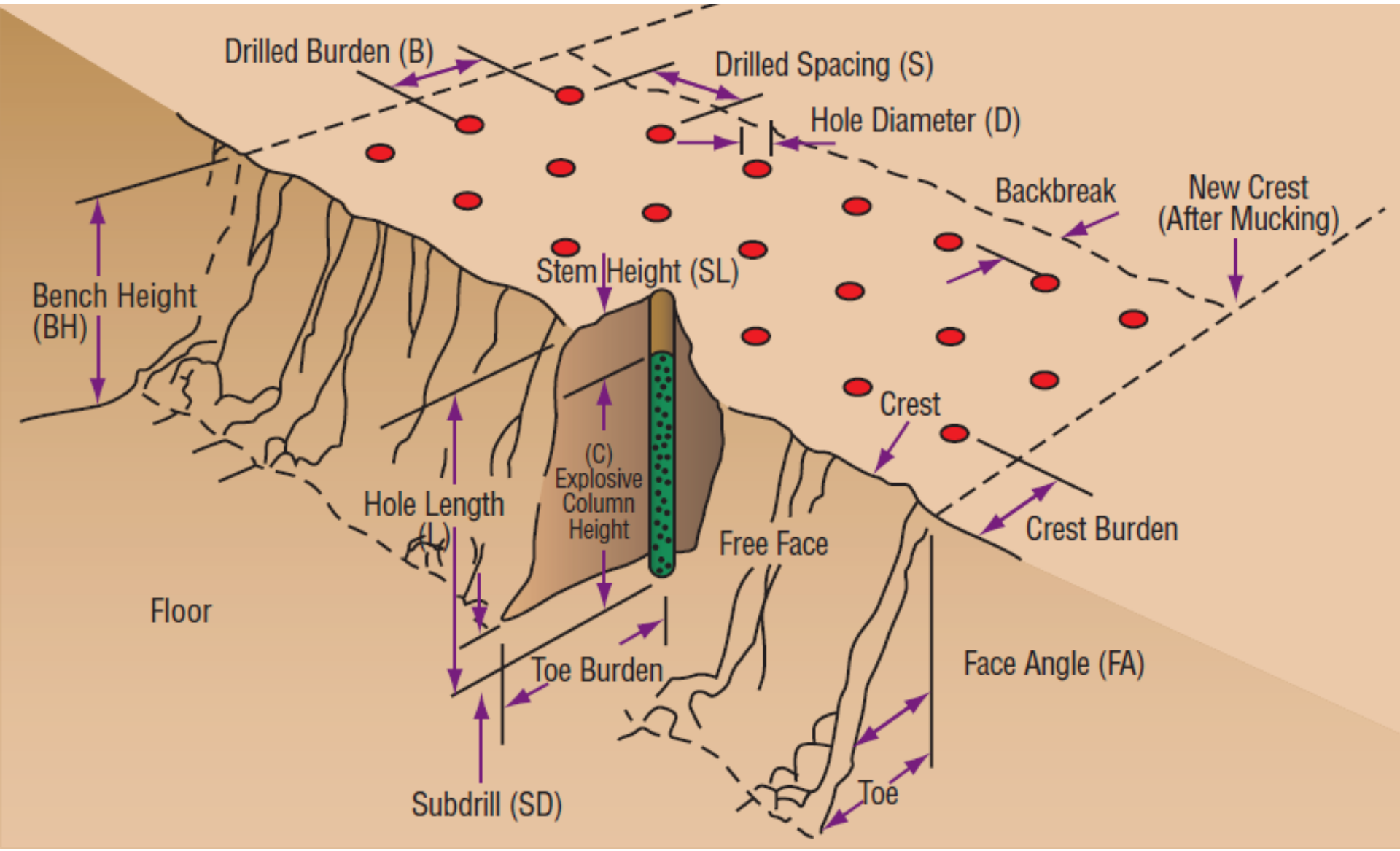
# Abbreviations

$\alpha$ = Angle subtended from the vertical by the inclined hole
$\pi$ = 3.1416 (the ratio of the circumference of a circle to its diameter)
**AWS** = Absolute weight strength
**B** = Drilled burden (m)
**BH** = Bench height (m)
**C** = Explosive column height or charge length (m)
**D** = Hole diameter (mm)
**L** = Hole length (m)
**N** = Number of holes in a blast
**PF** = Powder factor
**RBS** = Relative bulk strength
**RWS** = Relative weight strength
**S** = Drilled spacing (m)
**SD** = Sub-drill (m)
**SL** = Stemming length (m)
**T** = Blasted tons
**V** = Blast volume ($m^3$)

# The field of rock explosive engineering



# Equations to calculate what you need in the field

| | |
|---|---|
| Hole length (L) = | BH + SD |
| Charge length (C) = | L - SL |
| Blast volume (V) = | B x S x BH x N |
| Blasted tonnes (T) = | V x Density of rock in $t/m^3$ |
| Volume of blasthole (Vb) = | $\pi$ x $D^2/4000$ x L |
| Mass of explosive per hole (kg) = | Volume of hole length charged x Explosive density |
| PF ($kg/m^3$) = | Total explosives in the blast/volume of rock blasted (for kg/Ton, divided by blasted tons T) |
| RWS = | AWS of explosive/AWS of ANFO x 100 |
| RBS = | (RWS explosive x explosive density)/(ANFO density) |
| Energy factor = | PF x RWS |
| Vertical length of angled holes = | Measured hole length x cos $\alpha$ |

# Rules

These rules provide a first estimate in the absence of any better data.

- **Blast hole diameter** in mm ≤ 15 x Bench height (BH) in meters
- **Bench height** (BH) in m ≥ (Blast hole diameter (D) in mm)/15
- **Burden** (B) = (25 to 40) x (D)
- **Spacing** (S) = 1.15 x B (This gives an equilateral pattern)
- **Sub-drill** = (3 to 15) x D
- **Charge length** (C) ≥ 20 D
- **Stemming** ≥ 20 x D or (0.7 - 1.2) x B
- **Burden stiffness ratio** = BH/B : 2 to 3.5 good fragmentation
  : > 3.5 very good fragmentation
- **Stemming material size** = D/10 to D/20 (Angular material with minimum fines)

## Presplit blasting

- **Spacing** = Hole diameter x 12
- **Burden** = 0.5 x production blast burden (B)
- **Uncharged length at top** = 10 x D
- **Powder factor** = 0.5 kg per square meter of face

## Smooth Blasting

- **Spacing = 15 x Hole diameter (hard rock)**
  20 x Hole diameter (soft rock)
- **Burden = 1.25 x Spacing**

# Powder factors

## Typical powder factors used in mass blasts

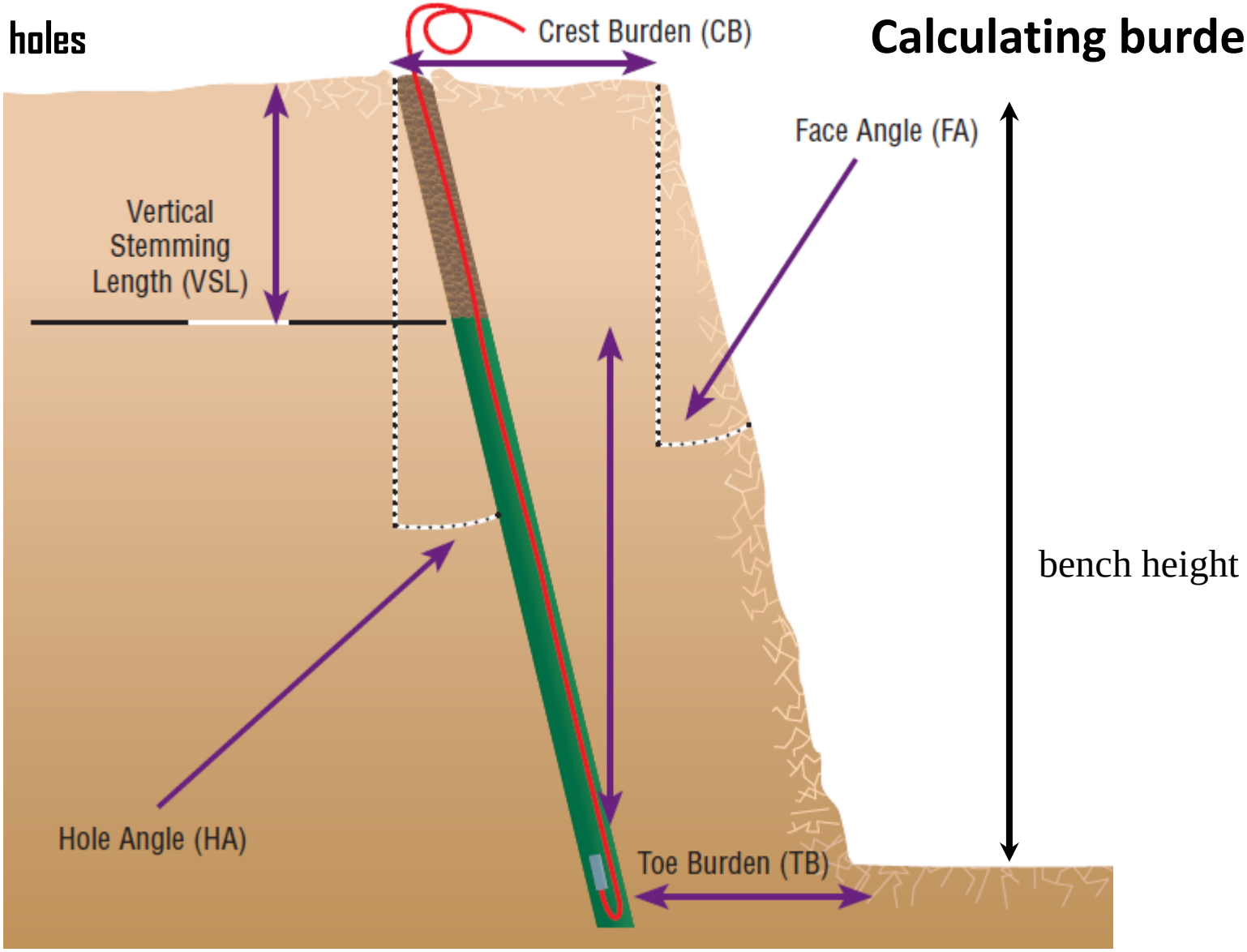
| **Rock type** | **PF ($kg/m^3$)** |
|---|---|
| Hard | 0.7 - 0.8 |
| Medium | 0.4 - 0.5 |
| Soft | 0.25 - 0.35 |
| Very Soft | 0.15 - 0.25 |

## Typical powder factors used in presplit and smooth blasting

| **Rock type** | **PF ($kg/m^3$)** |
|---|---|
| Hard | 0.6 -0.9 |
| Medium | 0.4 - 0.5 |
| Soft | 0.2 - 0.3 |

# Angle faced holes

# Calculating burdens




**Crest Burden (CB)** = Distance blast-hole collar is from crest

**Vertical Stemming Length (VSL)** = (measured stemming length x cos [HA])

**Toe Burden (TB)** = Burden at floor level

= ([tan (FA) x bench height] + CB) - (tan [HA] x bench height)

# Perimeter control

Perimeter blasting is a technique to reduce the over-break/back-break on a blast.

It usually utilizes decoupled charges in closely spaced blast-holes.

**The following formula can be used to estimate the centre-to-centre distances of cartridge product for pre-splitting.**

$$PF = \frac{L \times S}{0.5}$$

**PF =** Required powder factor (usually 0.3 to 0.6 kg/m$^2$)

**L =** Length of charged hole

**S =** Spacing between holes

$$D = \frac{L \times QL}{B \times S \times PF}$$

**D =** Center – center distance between cartridges (mm)

**QL =** Charge density of the explosive, in kg/m

**B =** Burden


Thank
You!