www.ranjan.net.np

# Selecting suitable explosives, initiating devices, blasting accessories

**Ranjan Kumar Dahal,** PhD, PostDoc, M.ASCE

Associate Professor,
Geodisaster Research Center, Central Department of Geology, Tribhuvan University, Kirtipur, Kathmandu, Nepal

7th Lecture

www.ranjan.net.np

## Selecting suitable explosives

- Selecting proper explosive is an important part of blast design to assure a successful blasting operation.
- Explosive selection is dictated by economic consideration, by rock type and by blasting results required.
- Several factors need to be taken into consideration while choosing a suitable explosive for a given blasting operation.



# Selecting suitable explosives

- Objective of blasting operation will have important influence,
- Surface mining/quarrying or for underground metallic or non-metallic operations.
- The equipment available, size of fragmentation, amount of displacement, allowable damage to the remaining rock, water condition, adequacy of ventilation, atmospheric temperature, propagating ground, storage conditions, sensitivity considerations and explosive atmospheres
- Cost of explosives and drilling.
- Initiating systems and charging techniques available are also to be considered.





# Factors affecting

- Economic factors;
- Explosives;
- Rock and blasting conditions;
- Blasting results.

# BLASTING RESULTS

- ***Fragmentation required***
- ***Special consideration***
  - **Products for dimensional stone blasting are the ones which provide decoupling and which are specially formulated.**
  - **These charges are 11 mm, 17 mm and 19 mm diameter and are formulated with special ingredients as there is possibility of these explosives becoming desensitised due to channel effect.**

Table 5.1 Comparison of explosives characteristics.

| Characteristic | NG | Slurries/ Watergels | Emulsions | Cartridged powder | F.F. power | Lox |
|---|---|---|---|---|---|---|
| Safety | Fair | Very good | Very good | Good | Very good | Medium low |
| Weight strength | All ranges | Desired ranges | Desired ranges | Medium | Medium low | Medium low |
| Life | Long | Adequate | Long | Adequate | Short | Very short |
| Water resistance | Good | Very good | Excellent | Poor | Poor | Poor |
| Density | High (1.4) | Medium (1.1-1.2) | Medium (1.1-1.2) | Low | Low | Low |
| Low temperature | Not affected | Affected | Not affected | Not affected | Not affected | – |
| High temperature | Not recom-mended | Not recom-mended | Recom-mended | – | – | Not rec-ommended |
| Coupling Ingredients | Poor Explosive | Good Non-explosive sometimes explosive | Good Non-explosive | Poor Non-explosive | Excellent Non explosive till mixed | Poor – |
| Medical aspects | Poor | Fair | Fair | Good | Fair | Fair |





# Initiating devices

- Commercial explosives are designed to be relatively stable for safe usage, transport, storage and manufacture. A powerful localised shock or detonation is required to initiate commercial explosives.
- This is achieved by use of an initiating device such as a detonator. In this chapter various initiating devices are described.
- An initiation system consists of three basic parts:
  1. An initial energy source;
  2. An energy distribution network that conveys energy into the individual blastholes;
  3. An in-the hole component that uses energy from the distribution network to initiate a cap-sensitive explosive.

## Initial energy source

- The initial energy source may be electrical,
- a generator or
- condenser discharge blasting machine or
- a power line used to energise an electric blasting cap,
- or a heat source such as a spark generator or
- a match.
- The energy conveyed to and into the individual blastholes may be electricity, a burning fuse, a high-energy explosive detonation or a low energy dust or gas detonation.





## Type of initiation

- **There are basically two methods of initiation, electrical and non-electrical**
- **Electrical initiation systems utilise an electrical power source with associated circuit wiring to convey electrical energy to the detonators.**
- **Non-electrical systems utilise various types of chemical reactions**

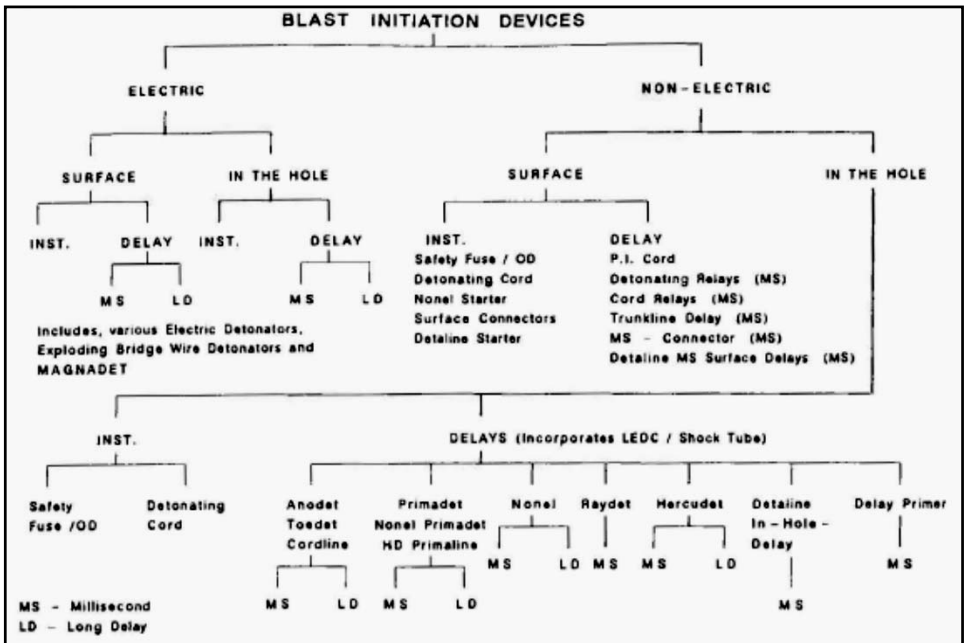


Figure 6.1 Various methods of initiation.

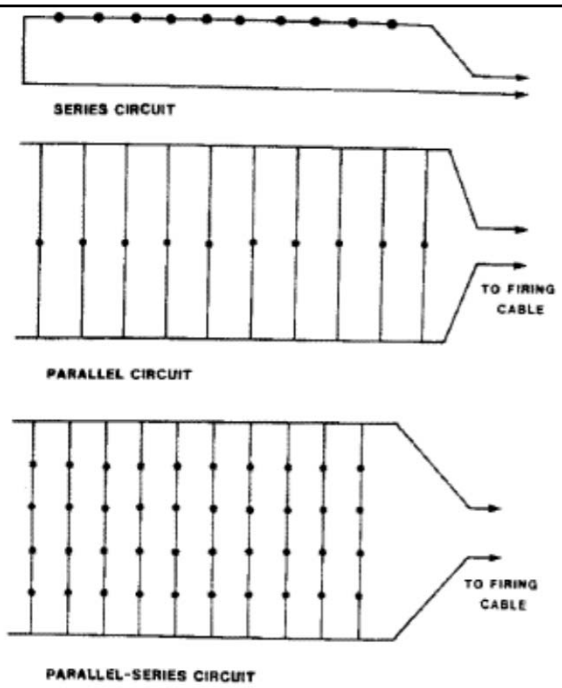




## Self study

- *Instantaneous detonators*
- *Delay detonators*
- *High intensity detonators*
- *Electronic detonators*
- *The Magna system*
- *Saf-t-Det*
- *Seismic detonators*
- *Submarine electric detonators*
- *Electric blasting circuits*

# Blasting circuits

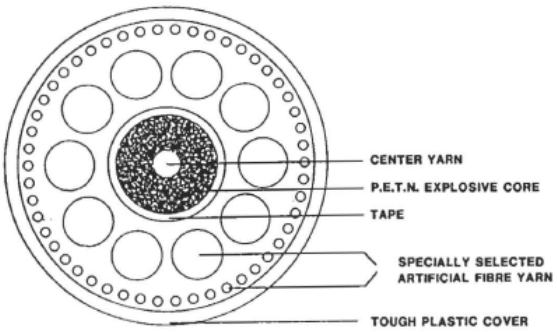



KAGAWA UNIVERSITY



# NON-ELECTRIC INITIATION SYSTEMS

- *Safety fuse and plain detonators*
- *Plastic igniter cord*
- *Detonating cord initiation*
- *Delay connectors*
- *Delay primers*
- *Redundant system*
- *Low energy detonating cord ( LEDC) delay systems*




愛媛大学 EHIME UNIVERSITY

7th Lecture

# *Non-electric systems not utilising detonating cord*

- 1. Hercudet,
- 2. Nonel,
- 3. Exel,
- 4. Raydet.

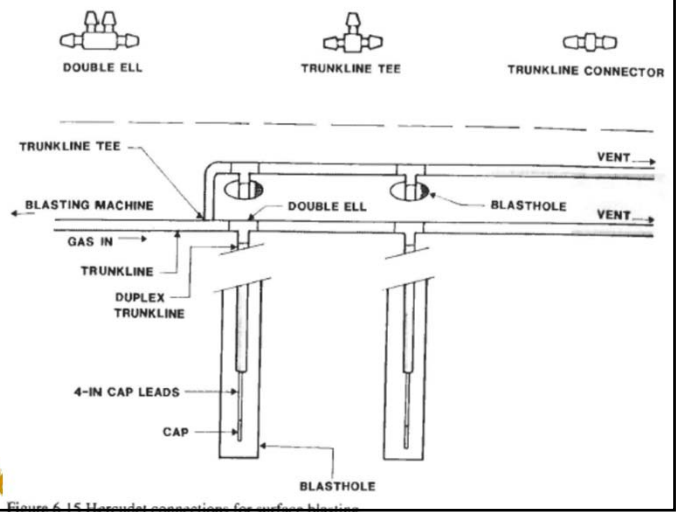



Figure 6.15 Hercudet connections for surface blasting



Table 6.1 Comparison of various initiating systems.

| Feature | Nonel | HEDC + delay elements | Electric detonators | Fuse and igniter cord | LEDC | Hercudet |
|---|---|---|---|---|---|---|
| Timing ability | Precise | Limited | Precise | Limited | Precise | Precise |
| Blasting capacity | Unlimited | Unlimited | Unlimited | Limited | Unlimited | Limited |
| Blasting adaptability | Most aspects | Mainly open pit blasting | Mainly U/G blasting | U/G and smaller and surface blasting | ANFO and large diameter slurries | Most aspects |
| External electric hazard | None | None | Electricity and radio energy | None | None | Water and dirt contamination |
| Airblast | Non-existent | Significant | Non-existent | Non-existent | Limited | Non-existent |
| Fire risk | Non-existent | Non-existent | Non-existent | Existent | Non-existent | Non-existent |
| Means of checking | Visual | Visual | Instrumental | Visual | Visual | Instrumental |
| Craftmanship | Unskilled | Unskilled | Skilled | Unskilled | Unskilled | Skilled |

HEDC = High-energy detonating cord, LEDC = Low-energy detonating cord.

# SELECTING SUITABLE INITIATING SYSTEM

- ***Type of explosive.***
  - Initiating systems employing detonating cord downlines may initiate high explosive or cause disruption of less sensitive explosive.
- ***Borehole temperature***
  - Special explosives and initiating system need to be usedwhen the borehole temperature exceeds 60°C.
- ***Geology***
  - Initiation system should be fully activated before rock movement occurs to prevent cut-offs.
- ***Hydrostatic pressure***
- ***Extraneous electricity.***
  - Consideration must be given to potential hazard from extraneous electricity when using electric detonators, since electric detonators are designed to be fired by a pulse of electrical energy which can come from many other sources and may lead to accidental ignition .





# Blasting accessories

- **Power source (exploders, sequential blaster or appropriate mains firing instrument);**
- **Blasting circuit testers;**
- **Non-metallic measuring tapes equipped with lead or non-sparking weights;**
- **Lowering ropes;**
- **Non-sparking lowering and retrieving hooks;**
- **Tamping poles (wooden or non-sparking);**
- **Blasting knives;**
- **Connecting wire (new -not reclaimed);**
- **Lead line;**
- **Blasting covering material (when applicable);**
- **Crimper (when blasting with safety fuse);**
- **Lightning detector.**

- a) Twist generator type exploder, b) Hand driven generator powered capacitor discharge exploder

Sequential blasting machine

cture



## Next class

- **Rock fragmentation process by blasting, influence of rock characteristics on blasting**
- **Seminar work: Download paper of** Sang Ho Cho and Katsuhiko Kaneko**https://www.jim.or.jp/journal/e/pdf3/45/05/1722.pdf and prepare a note on recent development on Rock Fragmentation Control in Blasting**
  - **Reference paper: BLASTING DESIGN FOR OBTAINING DESIRED FRAGMENTATION Stjepan Strelec, Mario Gazdek, Josip Mesec**
  - **Submission date: 2017/03/06 till 8 PM.**
- **Lecture notes in http://www.ranjan.net.np**