**Discussion on Firing pattern in Blasting:**

Bench blasting is normally carried out as short delay blasting. The firing pattern has to be designed so that each blasthole has free breakage.

The delay time between blastholes and between rows has to be long enough to create space for the blasted rock from the succeeding rows.

Studies have been made about the effect of the delay time on multiple row blastings that the rock must be allowed to move 1/3 of the burden distance before the next row is allowed to detonate. The delay time between the rows may vary from 10 ms/m (hard rock) to 30 ms/m (soft rock) but generally 15 ms/m of the burden distance is a good guide value.

This length of delay gives good fragmentation and controls flyrock, it also gives the burden from the previously fired holes enough time to move forward to accommodate the broken rock from subsequent rows.

If the delay between the rows is too short, the rock from the back rows tends to take an upward direction instead of a horizontal. On the other hand, too long a delay may cause flyrock, airblast and boulders, as the protection from previously fired rows disappears due to too great a rock movement between detonations. The increase in boulders is due to the fact that the blast in this case may be compared with a single row blast.

*Too short a delay between rows.*
Perfect delay between rows.

Firing pattern, multiple row blasting.
Above is simple firing pattern for a laterally constricted multiple row round. All holes in the row have the same delay except the perimeter holes, which are delayed one interval number to avoid excessive overbreak outside the limits of the excavation.

This firing pattern gives better fragmentation. The ratio between true spacing and true burden, S/B, becomes more favorable. (See wide-space drilling pattern.)

One disadvantage with the above firing pattern is the risk that the center hole in the second row of the blast may detonate before the detonators in the front row with the same delay number, due to the scatter within the delay interval. The hole will then be quite constricted causing incomplete breakage which will form boulders and possible butts above the theoretical grade.
This firing pattern provides separate delay time for practically all blastholes and gives good fragmentation as well as good breakage in the bottom part of the round.

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