QNJAC Joint Drill, Blast and Geotechnical Group

Toolbox talk on information and engagement in relation to the impacts that geotechnical management and drilling and blasting have on one another in a quarry operation.

This toolbox talk is aimed at Quarry Operators, Quarry Managers, Supervisors, Geotechnical Specialists and those persons carrying out drilling and blasting work at the quarry

Information and Engagement

Sources of information to be considered:

- Geotechnical assessments

- Meeting involvement of key personnel, who and when?

Geotechnical Engineer, Site/ Quarry Manager, Explosives Supervisor, Shotfirer

- Handover of information to other key personnel, to cover holidays, sick leave

- Other documentation to take in to consideration,; blast specification, near misses, daily face inspections, face heights, stability and the quarry design

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The Legal Framework- Shotfiring

The Quarries Regulation 1999, Blasting Specification

Regulation 25 – ACOP Paragraph 197. The specification should take account of:

- (a) experience gained from previous blasts at the quarry;
- (b) any unusual circumstances which are present or likely to arise;
- (c) the design of the excavation.

Appendix 2 to the Quarries Regulations 1999,

The following matters need to be addressed when planning, preparing for and undertaking a blast:-

No 6- Any geological anomalies which could affect the blast, in particular those identified during drilling and inspection. These might include the presence of cavities, clay bands, joint planes, bedding planes or discontinuities.

The Legal Framework- Geotechnical

The Quarries Regulation 1999, Regulation 30.

- *The operator shall ensure that excavations and tips are designed, constructed, operated and maintained so as to ensure that –*
- *(a) instability; or*
- *(b) movement,*
- *which is likely to give rise to a risk to the health and safety of any person is avoided.*

Regulation 30 –ACOP Paragraph 256. It is important to ensure that design, normal operation, inspection, appraisal and assessment work are not carried out in isolation from each other.

The Quarries Regulation 1999 Regulation 33 (3)

- *The operator shall ensure that any information available to him which may be relevant for the purposes of a geotechnical assessment is made available to the geotechnical specialist undertaking that assessment.*

Regulation 33 ACOP Paragraph 306. It is important to ensure that design, normal operation, inspection, appraisal and assessment work are not carried out in isolation from each other. Information gained as a result of all these activities needs to be shared.

Communication / Site Planning

Geotechnical

There is very little cross-over in the regulations but communication is considered to be vital and a legal requirement that all relevant information is passed between both the Explosives Supervisor and Geotechnical Specialist.

Closer communication may be achieved by having design meetings that are used to prepare and review quarry designs. A quarry design team may be composed of:

- The respective Geologist for the site,
- Quarry/ Site Manager (Reg. 8 1 c Appointee),
- Quarry/ Site Supervisor (Reg. 8 1 d Nominee),
- Explosives Supervisor (where applicable) (Reg. 25 (1) (b)),
- Geotechnical Specialist (where appropriate).

Information and additional assistance may be required from the following personnel:

- The regular operator of the face loading or excavating machine,
- Other face operators, e.g. drillers, shotfirers,
- Area Operations Manager,
- Estates Department, particularly on new developments,
- Relevant Senior H&S Advisor.

Quarry Design

The Quarry design should include sufficient detail to allow the quarry to be operated safely until the next review. The Quarry design may require additional information to be contained in other documents, such as the Excavations, Tips, and Shotfiring Rules. The Quarry Design should form part of the site Health and Safety Document and should be displayed in a prominent position that is readily available to site staff.

It is useful to produce a Quarry Design Plan or similar diagram that could describe the following items where relevant:

(items in bold are either the responsibility of the Geotechnical Specialist or Explosives Supervisor).

The following list is only a summary of contents relevant to shotfiring.

Geology

- general geology; rock/mineral type, setting e.g. karstic, river terrace, metamorphic, igneous.
- **geological discontinuities e.g. bedding planes, dip and azimuth, folds, including types, faults, including types, joints, intrusions, cavities/caves** overburden, base of deposit, clay partings or beds and **potential failure modes.**

Hydrogeology/hydrology/Dewatering

- **extraction beneath water.**

Drilling and Blasting

- **direct reference to site procedures for drilling and blasting**
- **effects of blast patterns on fragmentation**

Quarry Design

Faces

- **final face position and design, where these are to be achieved during the period covered by the QDP**
- **maximum face height**
- **working face angles**
- **face orientation**
- **minimum bench widths**
- limit of extraction
- **rock trap measures and design criteria**
- **direction of working**

Plant and Machinery

- **type and suitability for task e.g. reach, weight, manoeuvrability.**

Haul Roads and Ramps (access for shotfiring equipment)

- **design details e.g. gradients, width, edge protection measures, maintenance and drainage**

Beyond the Boundary

- **underground mine workings**

Examples of lack of cross-communication

Example 1

Some Quarry Designs incorporate faces which would have to be blasted at shallow angles (less than 70^{o} for example). These can be difficult to drill and load safely. Had the design team involved or consulted the Explosives Supervisor then these issues could have been addressed before practical problems arose. There are reported incidents of fly rock and misfires due to de-coupling from shallow angled shotholes.

Examples of lack of cross-communication

Example 2.

It is complicated to convert blast vibration into a seismic loading when considering the stability of tips and faces but not impossible. The use of real data is vital, such as peak partical velocity (p.p.v.), frequency etc. It would be helpful for the Explosive Supervisor to provide the Geotechnical Specialist with regression lines when blasting within 200m of any tip or face where failure could impact on personnel. As an example a quarry blast below destroyed a 40 year old restoration slope, HV powerline and crossed a public right of way as shown on the next slide

This could have been avoided but occurred when too high a blast vibration was transmitted through the structure. There were errors with the blast timing but the presence of the tip was not considered by the management or shotfirers. It occurred 17 minutes following blasting leading to additional concerns for personnel. Whilst the footpath had sentries at either end, failure occurred just before the path was to be reopened.

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Blastpiles, blast damage and pre- planning

1. Blastpiles should be appraised to see if they are a Significant Hazard. In some cases the height of the blastpile may exceed the height of the face.

2. The impact of blast damage is sometimes not fully considered but if the rockmass has a high disturbance factor there will be a high probability of more rockfall and face instabilities. As a result the rocktrap widths have to be designed to be wider, edge protection may be on unstable ground and there will be a reduction in mineral reserves.

3. The formation of a stable face is critical. Quarry designs often stipulate that presplitting or other mitigation such as smooth blasting should be undertaken. You are referred to the QNJAC Toolbox talk “Blast Designs and Techniques to improve quarry face stability”

(The link may be added here, once the document is published)