

Health and Safety Executive		Sector Information Minute	
Policy Group Manufacturing		SIM 03/2005/11	
Cancellation Date	13/12/2009	Open Government Status	Fully Open
Version No & Date	2: 13/12/2006	Author Unit/Section	Manufacturing Sector

Target Audience:
All FOD Inspectors
All SG Inspectors

FACE HEIGHTS AND SAFE WORKING PRACTICES IN ROCK QUARRIES UNDER THE FALLS FROM HEIGHT PRIORITY PROGRAMME

This is version 2 and replaces Version 1. The Quarries Regulations 1999 place an absolute duty on the quarry operator for excavation design, construction, operation and maintenance. Quarry operators should now be complying with all requirements.

The Work at Height Regulations 2005 clarify and consolidate previous legal requirements for work at height, and are also relevant to safe quarry design and operation, to prevent the risk of falls of persons, vehicles or materials from quarry faces.

This SIM informs inspectors on issues regarding the design of face heights, and the standards to expect. It also refers to good practice to prevent falls of persons or vehicles from quarry faces. Where conditions do not meet these standards, inspectors should investigate the underlying reasons why this is the case and take the necessary enforcement action to achieve compliance. This work contributes directly to the Falls From Height and Transport priority programmes, and indirectly to other Injuries Reduction programmes.

There are many other activities in the quarry industry with the potential for risk from working at height. However, these are not quarry specific. They can be addressed through general working at height principles and are not therefore discussed here.

BACKGROUND

1 There is an absolute duty (QR Reg 30) on the Quarry Operator to ensure the design, construction, operation and maintenance of quarry excavations and tips in such a way that any instability or movement which is likely to give risk to the health and safety of any person (note: whether or not they are working at the quarry) is avoided. This requirement affects slopes throughout the life of the quarry, and extends, so far as is reasonably practicable, to leaving the quarry faces in a safe condition when the quarry closes or ceases work (QR Reg 6(4)). This requirement exists whether or not the faces form significant hazards (QR Reg 32 and ACOP), which would in addition require geotechnical assessments by geotechnical specialists.

2 The Work at Height Regulations, Reg 10, include a specific duty to take sufficient steps to prevent or minimise the risk of, so far as reasonably practicable, the fall of any material or object; or where not reasonably practicable, to prevent any person being struck. This would include precautions to prevent the risk of injury from rock fall or tip failure. Reg 10(3) places a duty on the employer to ensure that no material is thrown or tipped from height in circumstances liable to cause injury to any person. This is relevant to various unsafe quarry operating practices such as end tipping. Regulation 10(4) on storage of materials is relevant to the stability of stockpiles.

3 Other working at height risks associated with quarry faces are the fall of persons working near excavation edges (e.g. drillers and explosives contractors preparing the next blast), and the fall of vehicles, either leaving haul roads or due to face or tip failure.

4 Current accident codings from RIDDOR reports do not allow analysis of how many incidents of “struck by a moving, flying or falling object” are face related, although these would usually be included under the accident agent “other material” which accounts for 41 accidents in the three years 2001-2 to 2003-4(p), or 3.5% of the total accidents. What is however clear from recent incidents is that poor working practices, inappropriate equipment and lack of face maintenance are leading to major or fatal injuries, due to rockfall onto persons or vehicles working below.

5 In the same three years, falls from height have comprised 131 accidents, or 11% of all accidents. Significant progress in reducing these accidents has however been made by the industry over the course of the last few years, with a high of 16% in 2000-2001 reduced to 7% by 2003-4(p).

QUARRY DESIGN ISSUES

6 The standard information source on rock slope design is contained in “*Rock Slope Engineering*” by Hoek and Bray, originally published in 1974 and subsequently revised and reprinted. Copies of the most recent 4th edition by Wyllie and Mah have been issued to each Quarry Inspector on personal loan. It is to be expected that the principles set out in this standard work will be known to those involved in the operational management, design, coordination and review of rock slopes.

7 The standard book on the design of UK quarries is “*The Stability and Hydrogeology of Quarries*”, published 1998 together with a handbook, by the Department for the Environment. The project was overseen by a steering committee consisting of members of BACMI and SAGA (now both part of Quarry Products Association), HSE, DOE and the County Councils Association, with authors from the Geoffrey Walton Practice and Nottingham University. The quarry industry should be conversant with the standards set out within it.

8 Inspectors should ask what formal training those involved in designing the quarry have had, with particular regard to the competence requirements for geotechnical specialists, defined in QR Reg 2(1). The Work at Height Regulations, Reg 5, also require competence and this includes reference to the organisation and planning for the selection of work equipment (see also paragraphs 10c, 10d and 13p below).

WHAT TO EXPECT IN A TYPICAL QUARRY FACE DESIGN

9 The Quarries Regulations consider the stability of the excavation in the following way:

- (a) The overall stability of the excavation based on the rock strengths, the jointing and discontinuities within the rock mass, failure modes, the external influences including hydrogeology, and internal stressors such as old mining, landslip, use of explosives, proximity of housing, infrastructure, etc.
- (b) The stability of the individual rock faces
- (c) The stability based on the excavation methods. Blast design needs to ensure that the resulting face is stable. The excavation equipment needs to be matched to the rock mass and it needs to be safe in operation.
- (d) The need to carry out daily and long term maintenance of individual faces, and the suitability of the chosen equipment and the design to allow this to be done safely.

Faces should be the lowest height which satisfies all of these criteria. Details of issues which should be addressed are included in Schedule 1 (Contents of geotechnical assessment) and Appendix 2 (Blast design) of the Quarries Regulations.

10 The following is an indication of the minimum expected from a competent quarry design.

- (a) An overall assessment of the geological features of the deposit, with particular reference to the strength of the rock mass, its relevant history, hydrogeology, external influences and structural orientation of the geological surfaces that will affect the quarry.
- (b) The designed orientation of the quarry faces to optimise stability for blasting and excavation, including failure modes and how they will be managed.
- (c) The bench elevation should be chosen to minimise the production of large rocks at the highest face elevations.
- (d) Details of the excavation method, selection of suitable equipment, and how this minimises risk to the quarry personnel
- (e) An assessment of the suitability of the design for short and long-term stability and maintenance of the faces.
- (f) An indication of the probability of failure or the factor of safety of the overall excavation.

- (g) The competencies, duties and authority of those involved in the design of the quarry and how they fit into the management structure.
- (h) The competencies, duties and authority of those involved in the coordination of geotechnical matters and production methods to ensure the safety of persons at or affected by the quarry workings.
- (i) Details of how the blast design is changed to take account of face orientation and the requirement to produce safe faces. This may include changing blast ratios, hole diameters or using specialist blasting techniques.
- (j) Details of the inspection and remediation scheme and the competence of those involved in identifying and implementing problems and remedial measures.
- (k) Details of what must be done before the quarry ceases operations or is abandoned to ensure that it is left, so far as is reasonably practicable, in a safe condition.

11 The tip and excavation rules should convey to all personnel the relevant design issues which affect their working methods. The tip and excavation rules should be regularly reviewed and their effective implementation monitored and audited.

12 In addition to the geotechnical issues the design must also allow adequate space for haul roads with provision for safety features as necessary, i.e. suitable road widths, with inner rock trap and berm, outer edge protection and face edge stand-off. Further information is available in Quarry Fact File 33 and the quarry industry pages of the HSE website.

ACTION BY INSPECTORS

13 Inspectors should check at site inspections and investigations the factors above and in particular that the health and safety document, tips and excavations rules and control measures address the following:

- (a) That there is a suitable design in place and that quarry personnel know the relevant parts of it.
- (b) That the design addresses types of failure which are likely to occur.
- (c) That the actual method of working is as set out in the design.
- (d) That the equipment being used has been assessed for its suitability, and is correctly sized to the face heights it will be working, so that maintenance can be carried out on both working and long term faces by mechanical methods. Further guidance is available in Quarry Fact File 32.

- (e) That where necessary rock traps (to allow any falling rocks to be stopped at the foot of a face without falling / bouncing into a working area), and crest stand offs (i.e. a safe distance back from the face edge to allow for potentially unstable shattered rock due to previous blasting) are stipulated as part of the design. (Regulation 11 of the Work at Height Regs, on Danger Areas, is directly relevant here.)
- (f) That the persons in the management structure, on and off site, are competent for the role and decisions that each has to take. Those involved in design and coordination should have received geotechnical training to Honours degree level (equivalent to level 6 or 7 of the National Qualifications Framework).
- (g) That personnel working the face are not being put at risk from faces that are poorly managed or maintained.
- (h) That suitable control measures are in place to protect persons and vehicles from falling from faces (edge protection, safe working practices for drilling and charging, etc)
- (i) That suitable excavation rules are in place, and that they are regularly reviewed by the management and safety committee or representatives.

14 Further details are given in the guidance to Quarries Regulations Regulation 6; guidance and ACOP to Part II, Health and Safety Management; Part III, Risk Control; Part V, Explosives; Part VI, Tips and Excavations; Schedule 1 and Appendix 2.

15 Inspectors are asked to report using the form given at Appendix 1 and send a copy to the Metals and Minerals Group, Manufacturing Sector, Cardiff, for analysis. Inspectors may also use COIN to record items of importance not covered on the form.

ENFORCEMENT CONSIDERATIONS

16 Enforcement is likely to be appropriate when:

- (a) The design is not adequate
- (b) Where there is evidence that the design is not being followed
- (c) Where the excavation rules are inadequate
- (d) Where the control measures are not being coordinated
- (e) Where the competence of the individuals and operator are not suitable for the risks at the quarry
- (f) Where the excavation method is not suitable for the excavation

- (g) Where equipment is not matched to the face heights and excavation methods
- (h) Where provision has not been made, through the design and operating practices, to ensure that when the quarry ceases operations or is abandoned it is left, so far as is reasonably practicable, in a safe condition.
- (i) Where edge protection and other measures to prevent the fall of persons or vehicles are inadequate or otherwise ineffective.

FURTHER INFORMATION

17 Further information on face heights is available in **Quarry Fact File** no. 32 and on the Hard Target Best Practice CD-ROM, which also contains information on haul road design, edge protection for persons and vehicles, and other WAH issues. Requests for copies, specific enquiries or geotechnical advice should be directed to the Metals and Minerals Group, Manufacturing Sector, Cardiff.

Date first issued: 13/12/2006

APPENDIX 1
(para 15)
FACE HEIGHTS AT QUARRIES

Inspector	Date
Client no	Operator
Location	Quarry

This programme considers the design and safe operation of quarry faces. Please tick the most appropriate box for each question.

	Yes	No	Comment
1. Is there a suitable design?			
2. Are there systems in place to inform employees of relevant parts of the design?			
3. Are the systems at 2 reviewed and audited for effectiveness?			
4. Does the design address the face failure mechanisms, which are likely to occur?			
5. Is the current method of working the quarry as set out in the design?			
6. Is working equipment correctly sized to face height? (see Quarry Fact File 32)			
7. Is there a suitable face inspection scheme?			
8. Is this inspection scheme reviewed and audited for implementation and effectiveness?			
9. Is this inspection being undertaken?			
10. Are those undertaking inspections competent to do so?			
11. Is face edge protection used to prevent falls by: (a) personnel (face barriers and harnesses) (b) vehicles (suitable road widths and edge protection - see Quarry Fact File 33)			
12. Is adequate face maintenance or remediation being undertaken?			
13. Does the design include where necessary rock traps and face stand offs?			

14. Have rock traps and face stand-offs been created where necessary in accordance with the design?			
15. Are those involved in quarry design competent for their role?			
16. Are those involved in co-ordination of geotechnical matters & production methods competent for their role?			
17. Are the tip and excavation rules regularly reviewed?			
18. Are the safety committee or employee representatives involved in reviewing the rules?			
19. Does the design include information on how to leave the quarry in safe condition before ceasing operations?			
Further comments (including enforcement action)			

Please return completed form to Lisa Weston, Metals and Minerals Group, Manufacturing Sector, Cardiff.