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Submission Re Code of Practice Ground Control in Open Pit Mines

1 Acknowledgement of Previous Submission

I acknowledge the submission made by Dr Anthony Meyers and generally support the comments that he has made and will not repeat submissions made by him in this document.

2 General Overview

The Draft Code (DC) author states that:

> *Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates. (p 3, para 4).*

If this is true, then I have general concerns with the DC which I outline within section 2 and address some particular points in section 3 of this document.

2.1 Document Audience and Tone

Despite introductory comments in the Foreword and, Scope and Application, it is not clear for whom the DC has been prepared. If it is supposed to provide technical guidance, the DC is inadequate and should simply have referred the reader to Read and Stacey (2009), amongst others, for current guidelines. If, as stated the document has *been "prepared to ensure that the mine operator at an open pit mine has undertaken adequate consideration of all ground control aspects*…" I would argue that (a) a document cannot ensure anything and (b) a check list without a brief technical commentary would be more appropriate. Stacey, 2009, Fig 1.4 provides a flowchart, shown below as Figure 1, that can be used as a high level check list for the mine owner.

The DC switches between formal passive voice tone and informal conversational style e.g. in p 4, para 4, the style is very conversational. I don't think this interchange of voices is appropriate for a quasi-legal document.

A number of sentences include phrases like "it is obvious" and "obviously". The immediate question this poses is: obvious to whom? And this returns us to the question who is the audience for this document.

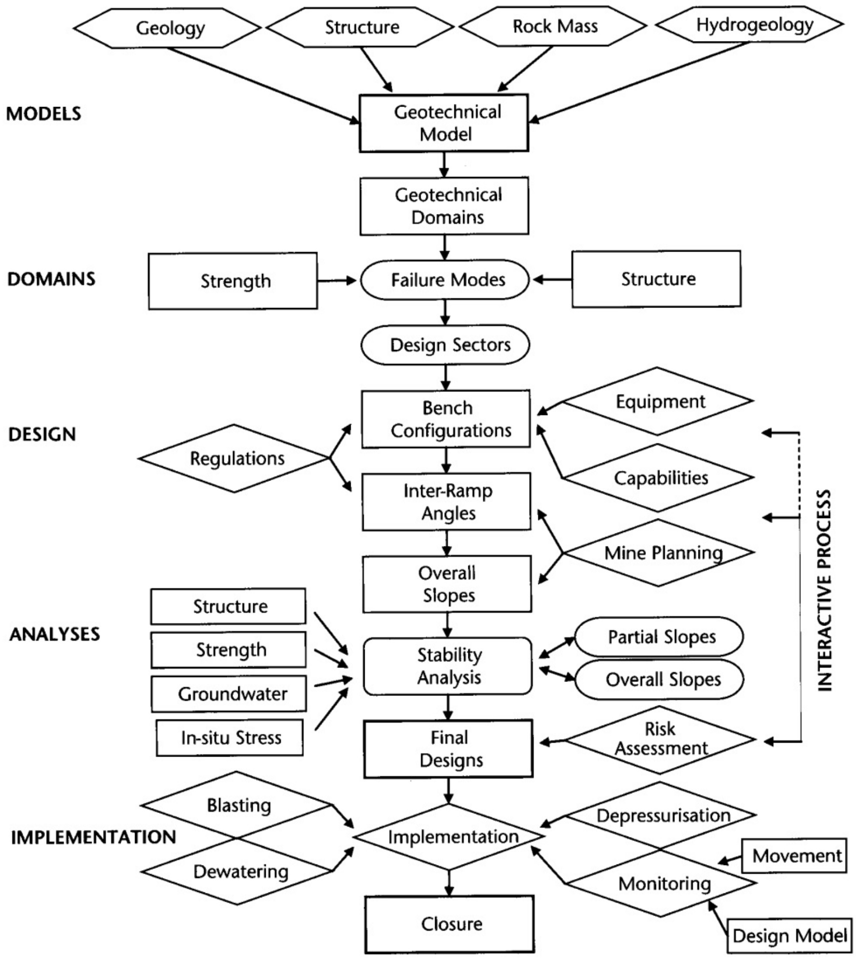

Figure 1.4: Slope design process

Figure 1 Slope Design Process from Stacey (2009).

2.2 Editorial Standards

The DC has clearly drawn heavily on existing documents that are recognisable to practitioners in the field. Notably, the DC has borrowed heavily from Read and Stacey (2009) and yet, while individual chapters are referenced, the book as a whole is not included in the references. This may be editorial oversight as it is inferred that the final line of the DC:

> *They provide a form of communication and corporate governance reinforcing current geotechnical practice (Read, 2009).*

refers to the whole of the book by Read and Stacey, not merely Read's sole author chapters.

The DC has been released without a thorough internal review and edit, resulting in various typographical and stylistic errors, for example:

- Confusion between i.e. and e.g., for example on p 8, para 3, dot point 7, the i.e. should be an e.g. since what is provided are some examples of sources of surcharge loadings
- Hyphentated "in-situ" (twice) when they are in fact two words and are used properly as "in situ" (4 times)
- Inconsistent use of "et al." (4 times) and "et al" (11 times)
- Wrong conjunctions e.g. p 8, para 4, EGC (effective ground control) is not achieved by the "successful management of four basic disciplines" as stated but by the successful management by four basic disciplines or better still by the application of four basic disciplines
- References to non-existent instances e.g. p 4, para 8 refers to the use of 'mandatory' but this is the only occurrence of the word mandatory in the whole DC.

These issues are raised not for the sake of mere pedantry but because the DC asserts it may be used in a court of law and a good many people could be held accountable by the standards of the final Code. Therefore, the integrity of the Code must be impeccable.

Dr Meyers has identified many editorial errors, but not all of them. The DC needs to be edited professionally before final release.

2.3 Uncertainty in Geotechnical Engineering

While the DC promotes a risk based approach to ground control i.e. a methods specification, it also mandates a performance specification e.g. p 6, para 4, "to ensure safe working conditions". Documents that specify both methods and performance criteria inevitably result in conflict when the method specified does not achieve the performance that is required.

In the case of ground engineering the issue is even more profound as we are dealing with inherently heterogeneous materials for which the properties can only be imperfectly known on the basis of limited sampling and even more limited testing. The late Dr Barry McMahon captured the dilemma faced by geotechnical engineers in his E H Davis Memorial Medal lecture titled "Geotechnical Design in the Face of Uncertainty" (McMahon, 1985) in which, he developed the concept of the "unknown unknown" as a key issue for geotechnical engineering.

The DC admits to the possibility of failure; see p 27, para 1, as follows:

> *A successful ground control program is not necessarily one that has had no rock mass failures. Success is measured by the level of awareness developed before any batter or large scale failure occurs, how geotechnical learning opportunities are incorporated into the pit design process over time, and how the safety and economic risks are managed.*

Under these conditions, it seems incompatible to hold the mine owner, and by implication the geotechnical engineer, to the level of accountability captured in the phrase “ensure safe working conditions”. Nobody can ensure anything in the face of an unknown unknown. A more rational approach, consistent with risk based management, is to utilise an ALARP (As Low As Reasonably Practicable) approach and to explicitly state that the design, implementation, monitoring and any other controls are aimed at providing a work environment in which the risk of accident is ALARP. Then, if something does go wrong, the mine planning and design (MPD) process described in Section 2.3 of the DC can be objectively examined as part of an improvement process instead of punishing someone for failing “to ensure safe working conditions” when they have followed the specified procedure.

2.4 Open Cut Coal Mining

The DC is very much hard rock-centric and this is reflected in the choice of references that have informed the DC. Read and Stacey (2009) barely mentions coal mining, and this is because the book is an outcome of a specific, industry sponsored project, concerned with metalliferous, large open pits. Hustrulid, McCarter and Van Zyl (2000) contains one chapter on coal mining viz. Seegmiller (2000) Coal Mine Highwall Stability. However, this is not referred to in the DC and should be. There is reference to Simmons (1995) but only in the context of recommended further reading for a discussion on the choice of a FOS, not the wider issue of geomechanics for coal mining. It should be noted that some of Simmons (1995) has been superseded by Simmons and McManus (2004). An additional source of information is the Kininmonth and Baafi, 2009, Australasian Coal Mining Practice which covers the whole range of coal mining practice.

The cover photo is of a trial pit in Central Queensland where the lower part of the pit consists of a single highwall batter, over 20 m high, excavated at an angle of 70°. There are mines where highwalls approach 60 m in height, that have no intermediate catch benches, and they are performing in accordance with design and safely. This needs to be acknowledged and the underpinning design guidelines and implementation included in the DC.

Another key issue for ground control in open cut coal mines is in-pit disposal of waste. The DC is silent on this issue. It should be addressed within the DC if the code is to have national application.

It would also be helpful to include some of the alternative terminology and definitions used in coal mining.

2.5 Highwall Mining

Highwall mining involves making excavations into highwalls using either an auger or an adaptation of a continuous miner. The method can be regarded as an extension to open cut mining, since it generally takes place in open cut coal mines once a final highwall or endwall has been established. Highwall mining can have an impact on wall stability, and there have been instances of wall failure due to highwall mining. The method is not mentioned in the DC and should be for the DC to be a complete document.

2.6 Waste Rock Dumps

The DC is silent on waste rock dumps and this should be addressed. In my experience, issues pertaining to waste rock dumps have resulted in more fatalities than any other geotechnical hazard in open cut mines.

3 Specific Comments on the DC Text

As noted above, I generally concur with Dr Meyers' comments and will try not to repeat any of his submission.

p 3, para 11, is:

> *and concerns the safety of both employees, visitors and any persons that may inadvertently entering the open pit mine…*

It should be:

> and concerns the safety of anybody entering the open pit mine. . .

p 4 para 3, Who should use this Code?
Tone is conversational and is not in keeping with the potential quasi-legal status of the Code

p 7, figure 1,
There would be some controversy regarding the inter-ramp slope angle as shown. Many would prefer to use the definition of inter-ramp angle shown in Stacey (2009), Figure 1.3 and shown below as Figure 2. Stacey (2009) states:

> *Note that the bench of face angles are defined between the toe and crest of each bench, whereas the inter-ramp slope angles between the haul roads/ramps are defined by the line of the bench toes. The overall slope angle is always measured from the toe of the slope to the topmost crest*

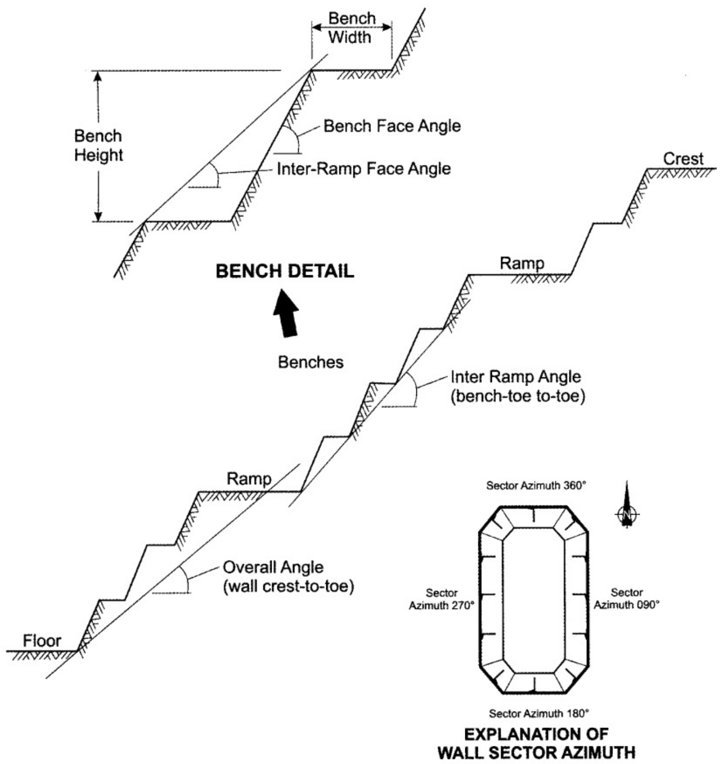

Figure 1.3: Pit wall terminology

Figure 2 Pit wall terminology from Stacey (2009).

p 8, para 1 and 3:

There are two instances of “diligent application of geotechnical engineering practice”

At the very least the use of the word diligent is superfluous, and the sentence should read: “application of geotechnical engineering practice”

p9, para 3, is:

> *Financial constraints, for instance, prohibit the mine from being designed for “permanent” stability, such as in civil engineering projects. Legal constraints can require significant alterations to mine designs; some of these may impact significantly on the economic viability of the mine.*

This paragraph implies that financial constraints permit acceptance of a lower level of safety which I doubt would stand much legal scrutiny. Mines are not “designed for “permanent” stability” not primarily because of financial constraints but because during production they are not permanent structures. A bench or highwall may only last for a few weeks or months before being mined out. Omit this paragraph.

p 10, Section 2.4, Geotechnical Design of Pit Slopes para 1 states:

> *The geotechnical design process for open pit slopes, regardless of the size of the pit or materials mined, shall adopt the following strategic approach:*

Is this meant to mean that the dot points that follow are mandatory?

Dot point 5 is:

> *Design implementation and definition of monitoring requirements.*

It should be:

> Define monitoring requirements, design and implement the necessary procedures.

Because the definition should precede the design and implementation.

p 11, Site Investigation

Para 1 refers to the collection of a wide variety of information but is silent on soil properties. This should be corrected.

Para 1 states:

> *Collection of this information for the geotechnical design of pit slopes should begin from day one in the development of a project.*

It should be:

> Collection of this information for geotechnical design purposes should start to occur as early as possible in the development of a project.

p 16, Geotechnical domains and design sectors, para 2, states:

> *…is a task that should be undertaken by geotechnical experts.*

How is an expert here defined? If the task is not carried out by an expert but by a merely competent geotechnical engineer would that negate the work? I doubt it, so the sentence should read:

> is a task that should be undertaken by suitably qualified geotechnical personnel.

If required, definitions as to what constitutes suitably qualified personnel should be provided e.g. CPEng, RPEQ, etc.

pp 18 and 19, Design acceptance:

Further to Dr Meyers' comments, it is clear that much of the material in this section of the DC has come directly from Wesseloo and Read (2009). The inclusion of their Table 9.3 as the DC Table 1 is all the more puzzling when Wesseloo and Read explicitly state:

> *Current industry experience suggests that the acceptance levels suggested by Priest and Brown in Tables 9.3 and 9.4 are conservative*

I concur with Dr Meyer's comments in regard to this section.

p 20, Batter and berm design, para 2, states:

> *In most open pit mines, batter heights are typically range from 10 to 20 m. In large open pit mines batter heights up to 30 m are not uncommon providing that the rock mass is strong and massive.*

This should be:

> In most hard rock open pit mines, batter heights typically range from 10 to 20 m. In large open pit mines batter heights up to 30 m are not uncommon, providing that the rock mass is strong and massive. In coal mines highwall benches of 60 m in height in medium strength, stratified rock are not uncommon.

p 25, Performance monitoring states:

> *Performance monitoring of open pit walls is required for essentially two purposes:*
> *1 To verify the geotechnical parameters and assumptions used to design the existing walls.*
> *2 To ensure that any potential falls of ground are detected prior to them becoming hazardous, and to establish appropriate trigger-action plans when ground movements are detected.*

It is not possible for current performance monitoring techniques **to ensure** (my emphasis) any potential falls of ground are detected prior to them becoming hazardous. Therefore this requirement is meaningless. As noted previously monitoring of hazards should be based on ALARP principles.

p 27, Ground Control Management Plan, para 4, lines 5 and 6 state:

> *They provide a form of communication and corporate governance reinforcing current geotechnical practice (Read, 2009).*

This should be:

> They provide a form of communication and corporate governance reinforcing current geotechnical practice (Read and Stacey, 2009).

Read and Stacey (2009) is the book that summarises current geotechnical practice in hard rock mines whereas the only other reference to Read (2009) in the DC refers to Read's Structural Model chapter in Read and Stacey (2009) and that is not correct in this context.

4 References additional to those provided in the DC

1. Kininmonth, RJ and Baafi, EY (eds.) 2009. Australasian Coal Mining Practice. Monograph 12, 3rd edn., AusIMM,
2. Read, JR and Stacey, P (eds.) 2009. Guidelines for open pit slope design. CSIRO Publishing 496pp.

3. Seegmiller, BL, 2000. Coal Mine Highwall Stability. In Hustrulid, WA, McCarter, MK and Van Zyl, DJA (eds) Slope Stability in surface mining. SME, Colorado.
4. Simmons, JV and McManus DA, 2004. Shear strength framework for design of dumped spoil slopes for open pit coal mines. In: RJ Jardine, DM Potts, KG Higgins, eds. Advances in Geotechnical Engineering. The Skempton Conference; Imperial College, London. Thomas Telford pp 981-91.
5. Stacey, P, 2009. Fundamentals of Slope Design in JR Read and P Stacey, P (eds.) 2009. Guidelines for open pit slope design. CSIRO Publishing 496 pp.