Design of barrier pillar for gentle angle deposit at Great Dyke Investments Platinum Mine, Darwendale, Zimbabwe

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Introduction

The Great Dyke Investments Platinum Mine is one of the main projects under development on the Great Dyke. It is situated on the Hartley Complex on ground highly infested with a high frequency of faults of and joints. The discontinuities coupled with the inclination of the orebody create geotechnical challenges in mine development designing of the access boxcut, the declines, the barrier pillar between the surface and underground room and pillar mining sections. The barrier pillar which serves as an unextracted buffer zone from the transition from the boxcut highwall to underground sections is critical to ensure that stress field or low strength factor from underground operations should not overlap with the boxcut high wall slope as this may lead to unstable slopes and cause global instability of the mine. The stability of the boxcut highwall is critical for the life of mine as it hosts the main mine access decline system, therefore the barrier pillar should have high stability factor resulting in elasticity that lasts the life of the mine.

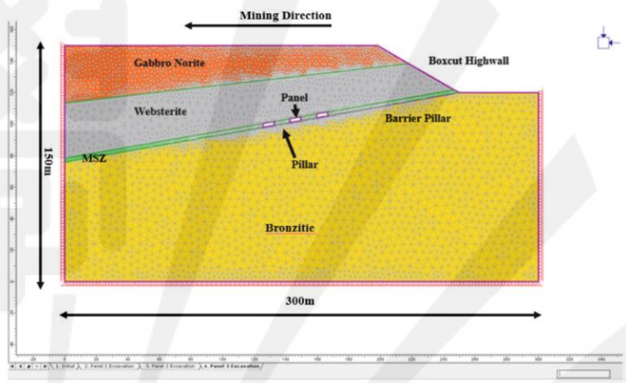


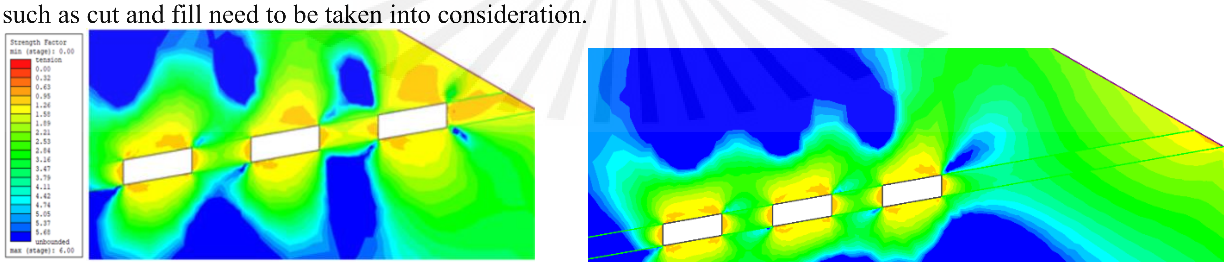
Figure 1. RS2 model of the case study

Methodology

In this study, Rocscience RS2 software was employed to undertake parametric studies on major parametrers for designing the barrier pillar and the optimum room and pillar design. Figure 1 shows the RS2 model geometry. Five approaches were utilized comprising of, firstly, analysing the effect of barrier pillar width of the case study situation assuming a 10^{o} dipping angle of the orebody, and room and pillar of 7m and 6m respectively. The effect of barrier pillar width and its effect on boxcut slope stability and the roof of the first stope were monitored Secondly, the effect of dip angle on barrier pillar stability was analysed for varying barrier pillar width (6m, 10m, 20m, 30 and 40m) and dipping angle from 0^{o}, 10^{o}, 20^{o}, 30^{o} and 40^{o} . Thirdly, the effect of rockmass condition deteriorated by fractures represented by from 30, 35, 40, 45 and 50 of GSI (Geological Strength Index) whilst also running a parametric analysis for optimum barrier pillar on the different barrier pillar width ranging from 10m to 40m. Optimum room and pillar design was analysed against the planned 6m pillar sizes. Lastly parametric analysis of the effect of inclination on the room and pillar design was analysed.

Results and Discussion

The effect of barrier pillar width was firstly analysed with the minimum allowable boundary pillar width according to Section 54 subsection (1) of The Mining (Management and Safety) Regulations (SI 109 of 1990) of Zimbabwe of 6m Figure 2(a). Based on the results, the 6m and 10m barrier pillar width at 10^{o} dip will result in unstable strength factor propagating to the boxcut slope rendering the boxcut and underground stope unsafe. It is also noted that as inclination or dip angle increase the strength factor the barrier pillar and the room and pillar are adversely affected therefore requiring more investment in ground support. Under adverse effects due to dip angle 40^{o}, alternative mining method such as cut and fill need to be taken into consideration.



(a) 6m barrier pillar effect on stope and slope stability (b) 30m barrier pillar stable stope and slope stability

Figure 2. Distribution of strength factor for 6m and 30m barrier pillar width at the case study area