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Evaluation of pillar design systems for low reef platinum mining

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ABSTRACT

Platinum is amongst the extremely valuable resources so every effort has to be made to ensure its safe and economic extraction. The success of a bord and pillar mining method in the exploitation of platinum heavily depends on a comprehensive and competent pillar design method. Pillars need to be large enough to contain load and to be small enough to avoid loss of resource. An optimum pillar design method achieves such a scenario. Without this a mine is destined for disastrous consequences either ways. A mine stands to lose revenue and threatens sustainable development if it tries to be conservative and leave too large pillars. On the other hand, leaving too small pillars can lead to large scale pillar failure with damaging consequences such as entrapment of expensive mining machinery, loss of life by workers, loss of invaluable production sections and all the severe effects of ground subsidence due to underground failure of pillars. While a lot of research has been done on the pillar design for coal industry, very little advance has been achieved in terms of this sort of research on hard rock mining. Of the research which has been done there are still more gaps to be filled and considerations to be made to come up with reliable pillar design systems.

The main objective of this research was to make a critical evaluation of the current pillar design systems used in low reef platinum mining so that more benefit would be obtained in the performance improvement of these systems. An extensive literature survey was undertaken in order to determine the present status of the design systems. As part of the research a review of the work done by the author on one large scale platinum exploration project and several platinum mines in Zimbabwe was also done. Through this approach the inadequacies of the current pillar design systems were highlighted and a proposition of areas of further research to get more understanding on how some neglected factors influence pillar system stability were brought forward. The work on the exploration project presented an excellent opportunity to map out areas of much care and consideration when collecting the geotechnical parameters used in designing pillars. The exploration work also highlighted how rockmass classification methods can be utilised in determining the overall strength of pillars.

The evaluation concluded that the current pillar design systems for low reef platinum mining mainly consider w/h ratio and the strength of pillar material as important parameters in designing pillars. However there are many more important factors which are not considered which have a bearing on pillar system stability. Some of the unaccounted for factors which were discovered during the course of the research are; contact of the pillar with the roof and

floor, roof and floor conditions, effects of adversely oriented joints, spalling and side scaling effects, influence of pillar loading conditions, blasting damage effects, influence of weak layers and weathering, impact of k-ratio, time dependent effects, geology, fractured zones, effects of different types of discontinuities within the rock strata, the list goes on. The observed pillar failures in the studied platinum mines are a testimony that these parameters have to be considered in determining pillar strength lest an over estimation of strength is done. Furthermore, the empirical systems do not embrace the fact that pillar design is a system. As a system, considerations of the roof, the pillar and the floor is mandatory since neglecting one component of the system will affect all system components.

The current pillar design systems are empirically determined. To calibrate the pillar design curve in empirical designs, pillar failure has to occur. While this may work for the mines lying within the empirical limits of the data used to develop the formulae, it is prudent for engineers to utilise tools which do not rely on failures. For the new mines which are to be established a tool should be availed with the power and capacity to design the pillars without waiting for failure to take place. While research costs time and money its fruits are worth it. It is the recommendation of this research that more research has to be done to quantify the influence of the above mentioned parameters in a bid to come up with a system that accounts for all factors affecting pillar stability. At the current level of research different combinations of the pillar design systems can be utilised in order to reduce error levels in the designs.