

**Mine Health and Safety Council Research  
Project SIM 150201**

<b>Project Title:</b>	<b><i>Development of methodologies for determining maximum spans (bord widths) applicable to platinum and chrome mines using bord and pillar mining method in the Bushveld Complex, South Africa</i></b>
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<b>Author(s):</b>	W.C. Joughin; S.K. Murphy; J. Walls; C. Zermatten	<b>Agency:</b>	SRK Consulting (South Africa) (Pty) Ltd
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<b>Report Date:</b>	July 2016	<b>Related Projects:</b>	None listed
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<b>Category:</b>	Safety in Mining	<b>Applied Research:</b>	Yes
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**Summary:**

<p><b>Background of the Study</b> The study stemmed from a knowledge gap, namely the apparent absence of a common and/or structured engineering approach in determining maximum spans in platinum and chrome mines using bord and pillar mining method in the Bushveld Complex, South Africa. This was partly motivated in response to several major falls of ground which had occurred in recent times - some of which had tragically resulted in fatalities.</p> <p><b>Objectives of the Study</b> The objectives of this study were to identify, or if necessary, develop a methodology for the design of maximum spans (bord widths) applicable to platinum and chrome mines using bord and pillar mining method in the Bushveld Complex, South Africa.</p> <p><b>Methodology</b> The approach used to undertake the study was multi-faceted. Personal interviews of key rock engineering personnel at a number of mines were undertaken and documentation relating to the design of maximum span was collected. Thereafter, a comprehensive literature review of material in national and international publications was undertaken. An initial design methodology was formulated and presented at workshops for further interrogation. Discussion elements from the workshops informed considerations and the methodology was refined.</p> <p><b>Results of the study</b> There was an expectation that the reports and codes of practice (CoPs) collected would clearly outline the bord design methodology applied at specific mines, however, it was the case that the documents were largely retrospective - for example, it was a common finding that after a fall of ground incident, the span width at an operation was reduced from X to Y - but no explanation was given of the methods used to calculate the new span width are given. Thereafter, it was found that a common approach was to use a rule of thumb method (taken from bord and pillar practices in the coal mining industry) where the length of support is designed by specifying a support height based</p>	<p>on a 95% fall-out height for different ground conditions or ground control areas. The approach has proven to be ineffective in preventing the falls of ground that have occurred.</p> <p>A methodology adapted from earlier work by Swart and Handley (2005) <sup>1</sup> was developed to address the project objectives. The methodology relates rock mass characterisation, potential failure modes (whether intact rock mass, structural, beam or rock mass failure), geometric optimisation and monitoring and draws on empirical design methods as well as analytical [computational] design methods for validation.</p> <p><b>Conclusions:</b> A methodology to determine maximum spans in platinum and chrome mines using bord and pillar mining method in the Bushveld Complex, South Africa was developed. An e-Book was prepared, which describes the project, theoretical underpinnings and the methodology in greater detail.</p> <p><b>Recommendation:</b> It is recommended that the methodology be implemented at various 'Champion mines' and subsequently any potential improvements to the methodology should be identified. The implementation, performance and outcomes of the applied methodology should be compared from mine to mine, in order to satisfy the adoption of a Standardised Guideline.</p> <p><b>Acknowledgements:</b> The research agency would like to thank the following institutions and persons for their valuable contributions during the research project: The Mine Health and Safety Council (MHSC) for sponsoring the research; the mines and rock engineering personnel that contributed their technical documents, data, knowledge, insights and availability during the site visits and interviews through the course of the project - Bathopele, Glencore (Kroondal), Impala, Lanxess, Lonmin (Marikana) on the Western Limb and Booyesdal North, Booyesdal South (Everest), Glencore (Mototolo) and Two Rivers Platinum on the Eastern Limb.</p>
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<sup>1</sup> Swart AH and Handley MF 2005, ' The design of stable stope spans for shallow mining operations, *The Journal of The South African Institute of Mining and Metallurgy*, vol. 105, pp. 275-286.