# Abstract

Rockburst occurrences and their consequent damage remain a problem in modern mining, particularly at great depth. The problem of rockbursts has also escalated in deep civil engineering tunnels due to high levels of in-situ stress at such depths. Key advancements have been made to date to help mitigate the drastic impacts caused by rockburst damage, with rock support remaining a line of defense to provide stability in rockbursting situations. There is, however, an ongoing inability of support to contain severe rockburst damage, especially conventional support systems.

More than two decades ago, a support concept termed "sacrificial support" was proposed as a potential additional method to help inhibit rockburst damage. The philosophy behind a sacrificial support system is that, under dynamic loading conditions, support, in the form of a liner must fail (*i.e.* be ejected from rock surface), leaving behind, undamaged, what was once supported rock mass. It is because of this reason that this support is referred to as a sacrificial support due to its ability to protect the rock from damage whilst the support itself fails. Since the inception of this support idea, it was only recently that the behaviour of support in real rockburst events manifested the sacrificial behaviour in rockbursting, which warranted the need for further research. The sacrificial support concept stated here is applicable in situations where the source (*i.e.* seismic event) of the rockburst is located remote from where rockburst damage is likely to occur.

To investigate the behaviour of sacrificial support, controlled laboratory experiments based on the split Hopkinson pressure bar (SHPB) technique were conducted to study some aspects of dynamic rock fracturing in tension at high strain rates, and also the role a sacrificial layer plays in combating dynamic rock failure (*i.e.* rockburst damage). To achieve this, a single Hopkinson pressure bar configured for spalling tests, comprised of a relatively long cylindrical intact rock specimen attached at the bar free end, was impacted by a striker on the opposite free end of the bar in order to generate a dynamic stress pulse responsible for spall failure upon reflection from the specimen free end. Different liners and/or liner combinations were then introduced at the specimen free end as sacrificial support. This experimental arrangement allowed the role of, and failure mechanisms associated with, sacrificial support under dynamic loading to be demonstrated, and comparisons were made with "sacrificial support" behaviour observed in real rockburst events in a mine. Analysis of experimental results revealed that varying liner thickness and mechanical impedance between rock and support liner plays a significant role in helping to limit rockburst damage.

Apart from experimental investigations, numerical simulations were undertaken to further probe the behaviour of sacrificial support under dynamic loading. Elastic models subjected to p-wave propagation indicated failure of the sacrificial layer, manifested by ejection of the liner due to reflection of compressive wave at the free surface. This failure mechanism was noticed for all the liners, independent of variation in liner thickness, and wavelength characteristic of the applied wave to the model. The sacrificial support method presented in this thesis presents an opportunity to further enhance safety in seismically active mines.