CHAPTER 8

CONCLUSION

A numerical modelling-based approach was developed to assess the effect of softcover on the strata and support behaviour in a depillaring working and evaluate the safe thickness of parting strata and optimal capacity of the goaf edge support for safer depillaring in such conditions.

The significant contribution of this work include :

(a) field representative simulation of the caving behaviour of strata, compaction of periodically filled caved goaf and failure mechanism of the parting strata during progressive depillaring under softcover in a given geo-mining condition
(b) Procedure for obtaining characteristics curve of peak goaf edge convergence and criteria for deciding the safe thickness of parting strata and optimal goaf edge support capacity
(c) Procedure for estimating the peak settlement rate and location of failure of the parting behind the goad edge and its relation with the efficacy of roof control
(d) A suitable orientation of the goaf line for easier caving of strata and reduced abutment loading in the depillaring working

Based on the findings of the study, the following conclusions were drawn:

i. For a given cover depth, the span of the main fall follows a non-linear increasing trend with increasing PS/SC, but it reduces with the increase in the cover depth.

ii. The front abutment stress ratio is reduced with an increase in PS/SC ratio at a shallow depth of cover. However, the maximum FASR remains almost the same while the AFASR reduces at higher depth.

iii. The considerable thickness of parting strata helps in controlled load transfer of the softcover, thereby preventing catastrophic settlement of the overburden. The maximum and the average values of the FASR reduced with an increase in PS/SC at the shallow depth of cover. However, the maximum FASR remained almost the same at higher depth while the average FASR reduced with the PS/SC increase.

iv. The maximum vertical settlement of the parting strata showed a consistently reducing trend with the increasing PS/SC. A sudden and considerable surge in the ultimate settlement of parting strata indicated an uncontrolled load transfer.

v. As the parting becomes thicker and the SC becomes thinner with increasing PS/SC, the extent of failure in the parting reduces for a given cover depth of the working. Thicker parting undergoes only a partial rupture for the lower thickness of the softcover as indicated by a relatively minor or insignificant surge in the maximum displacement, meaning its controlled settlement with progressive face in such cases.

vi. The maximum goaf edge convergence followed a non-linear reducing trend with an increase in the ratio of PS/SC. The MGECS showed a reducing trend with the increasing cover depth as well.

vii. The orientation of the tensile fracture plane was a good indicator of the adequacy of the parting strata to develop any arching effect for a controlled load transfer of the softcover and offset its load towards the central region of the goaf pile. Inadequately thick parting showed almost sub-vertical tensile fractures. In contrast, the thicker

parting showed fracture planes noticeably tilted towards the goaf area with a reduction in the fracture density, as noticed for PS/SC of 0.68 – 0.86 at the cover depth of 150 – 350 m. The tensile fractures that developed in the parting strata (PS) were almost sub-vertical for the lowest PS/SC ratio, indicating that the thickness of the PS was inadequate to create any arching effect for a controlled load transfer in the goaf edge region.

viii. Thinner parting strata settle faster under a dead load of thicker softcover at a given cover depth. Such failure of the parting causes higher compaction and a reduced cover pressure distance of the goaf material. However, the goaf does not attain the cover pressure even after a substantial goaf exposure for a very thick parting.

ix. The maximum convergence at the goaf edge is strongly related to the ratio of the PS/SC for a given geo-mining condition. The minimum thickness of parting strata (PS) for the safer load transfer of a given thickness of the softcover was decided for an acceptable maximum goaf edge convergence slope using the characteristic curve of maximum goaf edge convergence slope for different PS/SC. The minimum thickness of the PS can be determined by considering 75 mm/m of the maximum allowable convergence for containing the deterioration of the roof during the peak loading cycles of progressive mining within an acceptable limit.

x. The PS/SC ratio of 0.57 satisfied the design criteria of the safe parting thickness for the set of strata conditions in the parametric studies. Accordingly, the minimum parting thickness of 46 to 119 m was required for safer working in the presence of a limiting softcover thickness of 80 – 207 m at the cover depth of 150 – 350 m.

xi. The characteristic curves of the peak settlement rate (PSR) also confirmed the design limit of goaf edge convergence slope and the corresponding PS/SC for the controlled-load transfer. The failure in the parting strata was indicated 30 m behind the goaf edge in this condition.

xii. The estimated value of the safe PS/SC ratio was 0.74 for Kuiya Mine at the cover depth of 93 m. The mine workings with 44 m thick softcover required a minimum of 32.6 m thick parting strata for the safe extraction of pillars. The threshold PSR was 166 mm/m for the safe PS/SC in the prevailing conditions. The actual thickness of the parting was 17% smaller with respect to the minimum required for safer transfer of the dead load of the softcover.

xiii. The optimal capacity for containing the maximum goaf edge convergence within the safe limit at Kuiya Mine was 2 × 437 t.

xiv. As the actual parting was marginally thinner, it was expected to produce a slightly higher convergence of 80 mm/m at the goaf edge. The location of failure of the PS for the safe PS/SC ratio of 0.74 was 25 m behind the goaf edge, while the actual parting was estimated to fail 23.5 m behind the goaf edge.

xv. Mechanised extraction following straight-line extraction method in conjunction with continuous miner and mobile goaf edge support can be an appropriate method for faster extraction of developed pillars under softcover.