Basic engineering principles in the design of sandwich-pack support

by W. D. ORTLEPP*

Discussion of the above paper

by G. J. van JAARSVELD†

Mr Ortlepp's paper is important, and deals with a subject towards which much controversy and insufficient basic scientific logic, in my opinion, have been directed. He attempts to remedy some of our unscientific popular misconceptions, and for this we thank him.

However, I regret to say that experience has shown that some of his statements cannot be allowed to pass unchallenged.

In his opening paragraphs under the heading *Functional Requirements,* he states: 'Compression of a pack results from the elastic convergence of the stope . . . .' Has he any scientific theory or experimental data to justify this statement? If so, what percentage of his pack's reduction in height is due to this factor? In my opinion, the Witwatersrand quartzites are so rigid that downward movement due to elastic bending should for all practical purposes be disregarded; compression is due to ellipsoidally shaped blocks of strata resting on packs, after fracture. The shapes into which these blocks fracture are to a large extent unpredictable, and hence the complexity of the problem and the amateurishness of computations calculating the weight resting on packs. Nevertheless, these calculations are valuable and could be brought closer to the mark by research to determine the shapes and sizes of these blocks of fractured hangingwall.

Under the heading *Strength,* he says: 'The basic assumption is that a pack is required to carry the weight of a column of rock whose base extends midway to the adjacent pack in each direction . . . .' Should he not rather have opted for the 'cantilever theory'?

Under *Dimensional Factors,* he states: 'A convenient way to improve stiffness . . . is to increase the height of the concrete brick'. This statement is not understood; on the contrary, the graphs in Fig. 3 seem to indicate the opposite.

His findings under *Mode of Failure* are interesting and fundamental, and the opposite of what would generally be surmised.

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Author's reply

Mr Van Jaarsveld's contribution is welcome because it provides an opportunity for me to clarify certain points that were perhaps not adequately explained in the paper.

The fact that elastic convergence is appreciable and will, at a sufficiently large span, completely close a pack-supported stope is common knowledge to all deep-level miners. It has frequently been measured, notably by Hodgson and Cook (1967), and by Ortlepp and Nicoll (1963). Further, a cross-raise developed some 25 m back from a deep-level longwall face where about 50 per cent closure had occurred showed no opening of any kind for 15 m into the hangingwall. Thus, it is possible to state with complete confidence that the compression of packs, where they are adequate to prevent strata separation, is due solely to elastic convergence.

Naturally, where the packs are so 'soft' that they permit separation of strata a few metres above, they will be compressed more than the minimum imposed by the elastic deformation of the rock mass. To assume that compression is due to the 'dead weight' of the separated strata and not some smaller fraction of load resulting from a partly supported cantilever as Mr Van Jaarsveld suggests, does at least cater for the worst case. Furthermore, since it is known that face-induced fractures extend several metres into the hanging wall, the essential continuity of a beam simply does not exist.

The confusion caused by Fig. 3 in regard to the statement that increased pack stiffness results from an increased thickness of concrete arises from the fact that these graphs were presented to show that the thicker bricks resulted, after failure, in a weaker pack. The increased initial stiffness is better illustrated by the steeper slopes of the pack characteristics in Fig. 7, where packs of substantially increased concrete content were constructed from thin planks of timber.