Computers in Mining Industry

by

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Abstract : With the advances made in Computer Technology during the recent years, computers have come into use extensively in mining operations. Companies have specially developed minerals industry software which offer mining Engineers, data processing from exploration through to mine planning. One branch in which computers could be used even in Sri Lanka where the mining is more labour oriented, is in mine ventilation. This paper discusses the use of computers in the mining industry and takes an example from the branch of mine ventilation to show the advantages in using computers to plan out the day to day mining activities.

With the advances made in computer technology during the 1970's and in recent years, computers have come into use extensively in mining operations. The major areas of use are in ore body evaluation, statistics and geostatistics (not only the magnitude of the variable but also its position is considered), pit planning, mine surveying, design of drill patterns and blasting optimisation, remote control of underground plant and mining operations (eg. control volume of coal in u/g storage bunkers), mine atmosphere monitoring and ventilation.

Datamine is a specially developed minerals industry software that was launched late in 1983. It was developed with assistance from the technical services department of Rio Tinto - Zinc Corp. It took two and a half years to develop and offers geologists and mining engineers data processing from exploration through to mine planning. In a single package, comprehensive data capture and file manipulation facilities are fully integrated with a wide range of applications including data handling, statistics, geostatistics, seam or ore body modelling and evaluation, and open pit design. Its applications are reported to be wide not just for the mining corporations of the world, Datamine can be used on small portable computers and is therefore equally applicable to small mines. The software runs on any computer which supports Fortran 4 or 77, has at least 64 Kbytes core store, supports random (direct) access file handling, offers an overlay linker, a program chain facility or a virtual operating system and has at least 10 Mbytes available disk store. There are similar special developed software that are available at the moment (such as Sigma mine planning system - developed by Golder Associates).

As an example let us consider a mine ventilation problem. If the geometrical layout of a mine ventilation system is known, together with the resistance values for the branches and the position and pressure - volume characteristic of each fan, how can the distribution of air flow be calculated? If, in an existing mine, it is decided to change the ventilation system, perhaps by driving new roadways, closing off old workings, changing the position or duties of fans or merely by altering an airway resistance, how can the new pattern of air flows be forecast? It is these problems and others like them which the technique of ventilation network analysis attempt to solve.

As underground mines become deeper and more extensive, ventilation costs rise. It becomes increasingly important that the power expended in creating air movement be utilized efficiently. Ventilation network analysis enables the engineer to plan future airflow distributions based on a firm qualitative foundation, rather than on the intuitive estimates which have necessarily been all too common in the past.

For very simple networks, straight forward analytical techniques will suffice. Unfortunately, such methods can be applied only to localized sections of mines. In general, when applied to complete mine layouts, the analytical methods result in high-order equations which are difficult to solve.

Modelling or analogue methods, so popular in the nineteen fifties and early nineteen sixties have largely been superseded by iterative methods of numerical analysis using high speed digital computers.

The application of iterative techniques to even simple ventilation networks involves a considerable amount of arithmetic. For practical mine systems, iterative methods become impractical if the repetitive calculations are to be carried out by manual means. Small desk-top computers assist in the calculation of mesh correction factors and the application of these to branch flows.

However, the number of iterations which may be required, together with the organizational procedures of mesh selection and network updating still involve a great amount of tedious work.

The modern approach is to automate the complete process fully by using the larger and faster computers. A number of computer programs have been developed for this purpose, requiring between 5000 and 15000 words of computer memory store, depending upon the complexity of the program, the language in which it is written and the size of the network to be analyzed. The availability of such programs reduces the manual work to that of specifying the data which described the network.

Operation of Programs :-

The major routines of a typical ventilation network program and the relationship between them are illustrated by the simplified flow chart shown in Fig. 1. This chart refers to a program which utilizes the Hardy Cross iteractive technique and prints out a flow analysis for cumulative exercises carried out on the initial network.

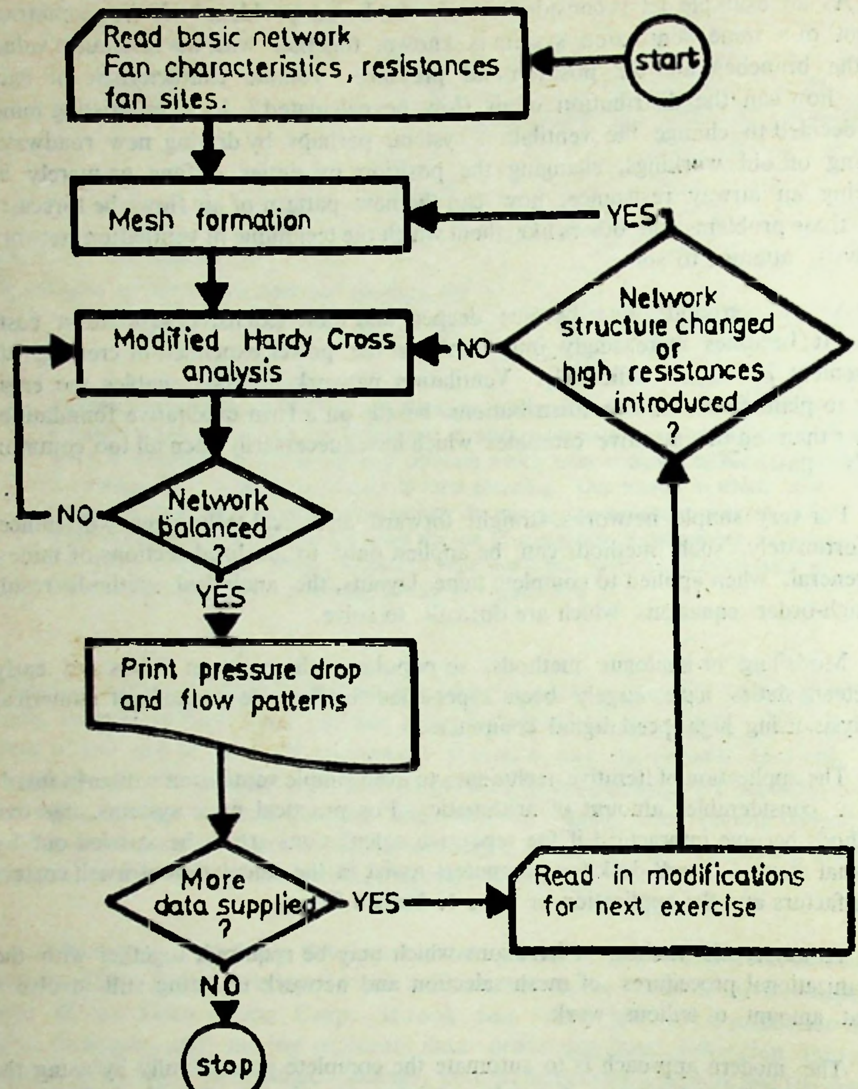

Fig. 1

It should perhaps be emphasized that the utilization of these programs does not require a knowledge of their method of operation. The ventilation engineer is intimately concerned with the preparation of his input data and the investigation of computed results, but not with the mathematical and programming intricacies which connect the two. Nevertheless, the engineer who acquaints himself with the main principles is likely to use the programs more efficiently and gain a better understanding of the significance of his results. The operation of each of the main segments of a ventilation network program is outlined below with reference to Fig. 1.

Data Required as Input :-

The precise form in which input data should be supplied varies from program to program. Furthermore, local variations may occur because of restrictions imposed by the computer system employed. The basic information which is required for the routine analysis of an airflow network includes :-

(*a*) For each fan, its position and either a characteristic curve specified as pressure-quantity co-ordinates, or a fixed pressure. Fan pressure is used here to indicate difference in total pressure across the fan.

(*b*) The natural ventilating pressures which exist in specified loops

(*c*) The geometry of the basic network and the resistance of each branch.

(*d*) The specification of exercise data. Each exercise will consist of one or more modifications to be made to the network last analysed during that run of the computer. A flow pattern will be produced for each exercise. The modifications which are required most often are:

(*i*) change of resistance values;
(*ii*) introduction of new branches and junctions;
(*iii*) removal (sealing) of old branches;
(*iv*) change of fan duty;
(*v*) change of fan position:
(*vi*) variations in nvp's arising from climatic variations or underground fires.

Output Results :-

The precise form of the output will again depend upon the particular program being used. The results from the initial network and each subsequent exercise will consist of at least the frictional pressure drop and airflow for each branch. Also included may be the branch resistances and details of the modifications made between exercises. The more sophisticated programs carry out checks for unlikely situations such as reversal of airflow or very low values of resistance and print out suitable messages to highlight these circumstances.