LAND SURVEY DATA BASES IN

OPENCAST COAL MINING

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ABSTRACT

The involvement of specialist departments in the Opencast Executive is radically changing at the present time. This change may be attributed to one prime cause - integration. It is no longer possible for any single professional discipline, whether Engineer, Geologist or Surveyor to work in isolation, much of the data used by any is common and with the advent of cheap data storage and processing devices, data bases, suitable for multi-discipline use can be set up. This paper describes the work done within the Land Survey Branch in the collection of processing of special data and making this data available to other user departments.

The Survey Database

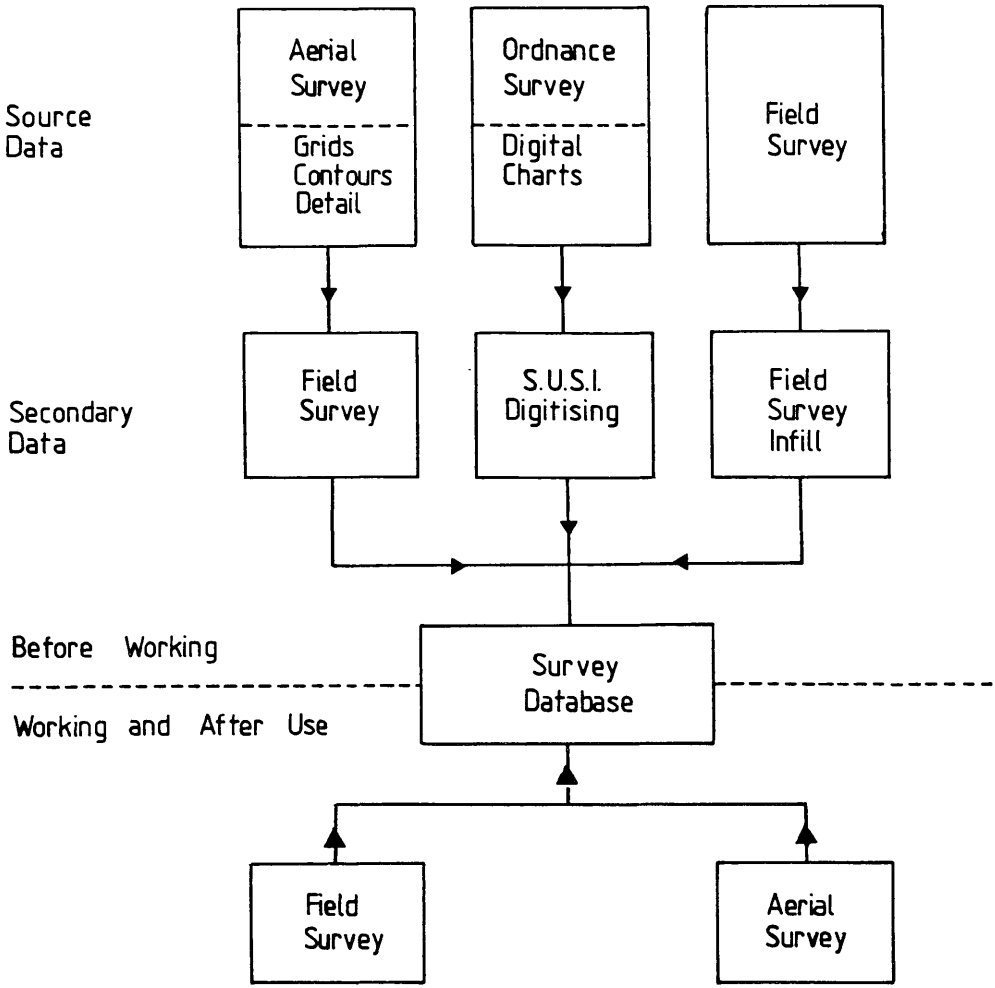

Diagram 1

INTRODUCTION

The Opencast Executive are responsible to British Coal for reserves assessment, evaluation, planning and supervision of opencast coal mining operations in England and Wales.

Geological, economic, social and political considerations determine that many sites over a wide geographical area are required to maintain production targets, currently 15,000,000 tonnes per annum.

At each stage in a site's development there is a need for land survey and site survey information and it is the intention of this paper to show how this information is prepared and ordered to allow user departments access to the Survey data. Many types of data are required:

At the prospecting stage to allow drilling units to operate in safety the location of service apparatus - gas mains, water mains, electricity cables etc. must be determined and a plan produced for use by the geologist or drilling operator. Further requirements are for contour plans to allow detailed drilling rig movement and during the drilling phase on site, the location and surface level of all boreholes have to be measured to allow geological interpretation to be made. The number of boreholes may vary on a site from a few tens on a small geologically simple site to hundreds if not thousands on a large complex site.

Where economic reserves have been proved and the working of a site has been decided an essential requirement for the planner is having an up-to-date plan of the area of interest available when considering detailed opencast proposals. Planning procedure within the Executive deems the use of maps and plans based upon 1:1250, 1:2500 scale maps produced by the Ordnance Survey G.B. The use of these plans involves up-date utilising ground or aerial survey methods by the land surveyor.

All opencast coal mined in Great Britain is produced by private contractors working under contract, or under licence granted by the Executive.

SOURCES OF DATA

The data required by the specialist department has to be presented in one of two ways, in the form of a plan or map or as part of a created database where the user can access the survey data and use it within his system.

The various data sources are:

1. Aerial Survey
   Ground Survey
   External Sources

These are shown in diagram 1.

AERIAL SURVEY

The Opencast Executive has an aerial survey contract with a contractor working in the private sector. This allows vertical aerial photography and mapping to be undertaken, the mapping is the main element for consideration here. Various items of mapping are allowed for under the Contract,

contours, grids of spot levels, machine plot of detail etc. Mapping may be produced as a drawn plot or as digital information on a diskette media, the diskette media compatible with our developed computer system.

Further discussion will be restricted to digital information only.

Aerial Survey information is requested as four types:

Grid Levels
Spot Levels
Contours
Detail Survey

A standard file structure has been adopted for the first three options. Detail Survey is to the Moss Consortium 'DIGIT' format.

The files created on the diskette are a sequential ASC II coded file, the names of files on diskette are an abbreviation of the Site Name, the file extension reflecting the last 3 digits of the sequence number attribute. (e.g. Site Name - Great House Extension, Sequence No. = 0031; File Name = Great HOX. 0031)

Data Structure - Aerial Survey

File Header

A file header block providing full data content is present on all files using the standard O.E. file structure and constitutes the first seven records of the file containing the following data.

Record	Description
1	Site Number
2	Site Name
3	Date of Photography
4	Contract Code
5	Sequence Number
6	Data Type
7	Interval (Contour/Grid)

Data Block

The remainder of the file constitutes the data block. The data block records are fixed length records having the same field structure for the first three mapping options.

Record	Description
1	String Flag
2	Grid Easting Value
3	Grid Northing Value
4	Level

For grid levels the 'string flag' will be a zero character records 2 and 3 being divisable by the interval indicated in record 7 of the header block and for spot levels the 'string flag' is filled with a zero character, records 2 and 3 accurately reflecting the position requested for spot levels. Level values in both cases being indicated to the nearest 0.1 metre value.

For contours the 'string flag' field is used to indicate the beginning of a new contour string, the first point on a contour string having a 'I' character in the 'string flag' field remaining points having a 'o' character in this field.

Detail Survey

To allow users access to the use of MOSS systems for some aspects of its work MOSS DIGIT format is required this is prepared to the specification laid out in the Moss Modelling Systems Manual (ISBN 0 86260 009 X).

The aerial survey information is retained by the aerial survey contractor, should replacement copies of the data be required by the Executive at a later data.

FIELD SURVEY

The primary source of data input to the database is from field survey sources. within the system developed by the Executive traditional methods of field survey are catered for e.g. optical tacheometry, chain and offset etc. It is with more recent survey instrumentation and collection devices that systems development has been concerned with.

'Total Station' survey equipment, in the case of the Executive, exclusively AGA Geotronics equipment, and electronic field recorders (A.M.S. Numerics Datasafe II) allow relatively error free and rapid collection of field data. As well as a collection device the field recorder employed may be used as a field computer utilising a suit of programs developed in-house.

A field coding system has been developed to allow all surface and sub-surface features to be properly identified at the computation and editing stage and the resultant data stored in the database.

The coding system has four main elements:

1. Point identifier
2. Additional numeric data
3. Plotting instructions
4. Remarks/reduction instruction

The point identifier is split into two sections, a descriptive two-letter numeric (e.g. KB = Kerb, MH = Manhole etc.) and a numeric identifier to distinguish between feature of the same type (e.g. FE1 = Fencel, FE2 = Fence 2). Additional data may require storage for a tree of Girth = 2.4 metres, Height 10 metres, Spread 12 metres e.g. this would be input as:

TE 2.4 10 12.5

Blank fields separating the various attributes on the input device. The string concept is employed in data processing, two symbols are used to denote the start of a string (*) e.g. *KB would denote the start of a kerb string and form to point number (#) is employed.

Remarks/Reduction instructions may be placed after all other elements have been entered. e.g. BG! BAY WINDOW. Any remark being limited to 16 characters, also reduction instructions for offset or reflector height changes when using total station may be input.

Downloading of the field data is done through IBM PC AS or Hewlett Packard HP 85 personal computers.

PRODUCTION SITE SURVEY

As already stated, all opencast mining operations are carried out through contract with the private sector. This necessitates the provision of two sets of data - management information and field data, the first being derived from the second.

The field data comprises in the main of point data with point attributes. The point data being spatial data referenced in both position and level to the O.S. National Grid and Datum. Attribute information may be of several types dependent upon its proposed usage.

For example a detailed record has to be kept for each coal seam excavated on an opencast site. Record has to be made of seam thickness, seam dirt partings, old workings voids, geological considerations within the seam, each of these items are considered as a seam attribute.

It may be that a discrete survey point has several attributes.

1) Grid Eastings Value
2) Grid Northings Value
3) Level relative to Datum
4) Seam Thickness
5) Parting Thickness
6) Old Working Thickness
7) Washout in Seam
8) Fault in Seam

This list is not exhaustive but indicates the possible attributes.

During the working of a site several thousand points may be surveyed in its life, this demands the creation of large data-bases.

EXTERNAL INFORMATION

The basis of all maps and plans used within the Executive are based upon Ordnance Survey publications at 1:1250 and 1:250 scale. Two source documents may be required to allow this information to be placed on the database. The Ordnance Survey has available digital mpas for some areas of the United Kingdom where these cover an area of interest they are incorporated into the database. Should the printed chart sheet only be marketed this is digitised in-house and incorporated.

LIKELY COMPUTER CONFIGURATION

FOR AREA OFFICES

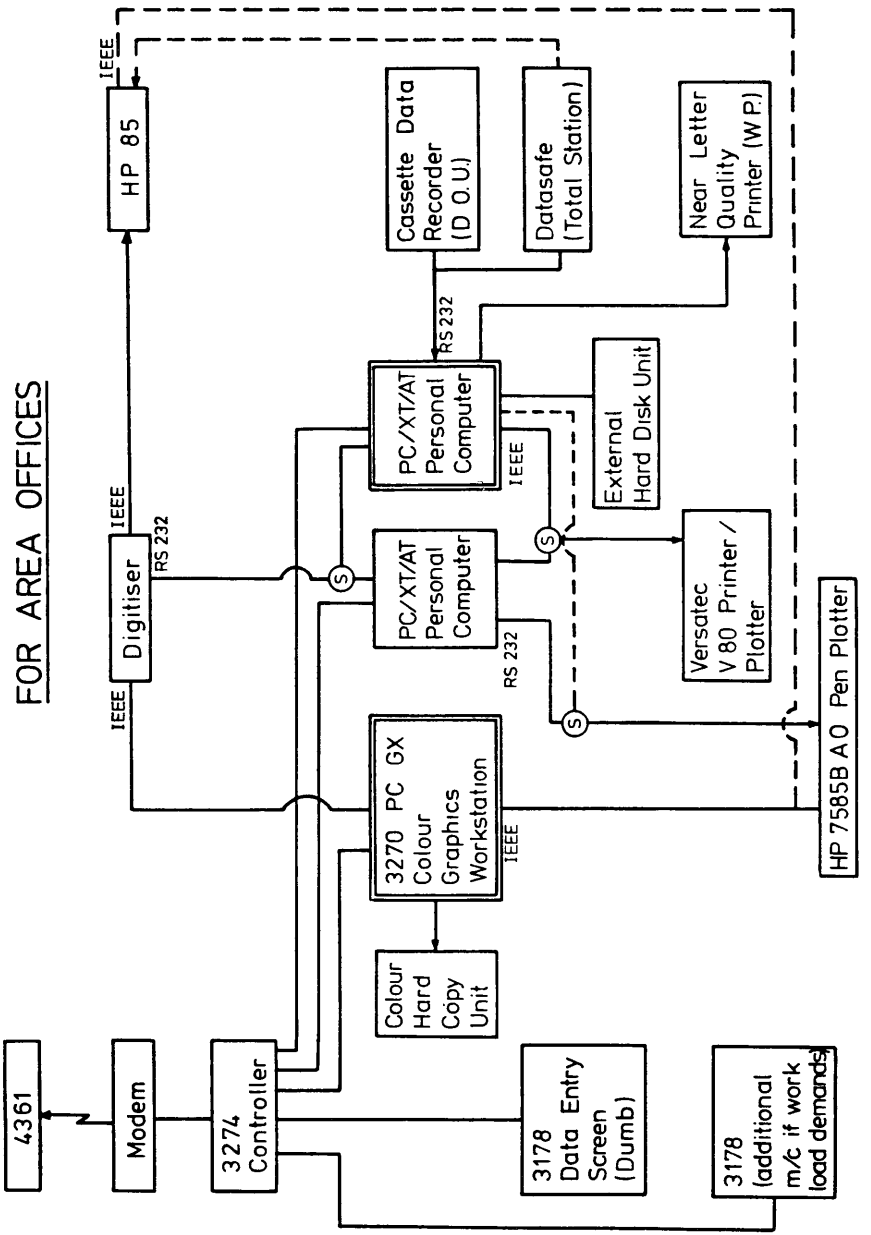

Diagram 2

It is frequently the case however, that these plans are insufficiently up-dated for our requirement reference has to be made to the Ordnance Survey SUSI (Supply of Unpublished Survey Information) Service for plans which are in chart form. These are subsequently digitised into the database.

STRUCTURE OF THE DATABASE

As far as land survey branch is concerned a layer approach has been adopted for database structure. Each set of similar surface and sub-surface elements being considered as a separate layer. A menue system has been developed using the Auto Cad drafting package as provided by Auto-Desk. All menus are interactive and allow layer changing and merging and snap selection for lines and data type insertions. Many layers of data sets are required for a typical opencast site ranging from utility information, contours, grid levels and surface feature at the pre-working stage through to coal seam data, seam contours and seam attributes required for abandonment record. Some fortyfive layers of data required have been identified to date.

The field data besides being presented a data base suitable for interrogation by engineer or geologist has to be presented in the form of a plan or report.

Seam plans are stored digitally, the digital data is presented on V.D.U. or as a plot-out utilising the Auto-Cad drafting package and management reports, usually in the form of quantity information, is easily accessed from the database.

COMPUTER FACILITIES

Administration of the Executive's work has resulted in the setting up of ten area offices throughout England and Wales.

All technical disciplines, surveying, engineering, land management geology etc. are represented. To allow access to databases currently available a distributed computer network has been set up the main features of which can be seen in Diagram 2. This facility is administered by a nominated departmental head who has overall responsibility for scheduling and liaison with development matters.

Common utilities such as word processing, program editing and spread sheet analyses are installed with specialist software for survey data handling, survey reduction, drafting and contouring available for the Land Surveyor.

DATA PROCESSING

A complete suite of programs have been developed in-house to allow data transfer, processing of data and the output of data to the required medium.

At all stages of processing editing options are available to ensure the correctness of the database to the satisfaction of the Surveyor. Also, as database is guaranteed through the use of security procedures and the keeping of back-up copies of the processed data.

CONCLUSION

The use of survey databases is still in its infancy within the Executive. Much of the work done to date is still of an experimental nature. Where full survey systems have been employed many advantages have been found - in data collection, data processing and in the utilisation of the derived database in plan and management reportage.

However complete integration of the survey data with that of a geological or engineering database and the transference of data between such databases has as yet not happened. This because systems have not been developed through, this is under current development, rather than to any short-comings of the database itself.

Biographical Information

John Kidd after formal training as a Mining Surveyor in the National Coal Board Scottish Division, joined the Opencast Executive in 1971 as a Land Surveyor in the Scottish Region holding subsequently Area and Regional posts. He is now Executive Land Surveyor for the Executive responsible for advising on land survey activity in the north of England.

Martyn Lovatt joined the Opencast Executive on leaving school and after a period of training as an assistant Land Surveyor was partly responsible for the development of an automated survey system. He is currently Area Land Surveyor for the West Midlands Area of the Executive and is based at Cannock.