LOCATION OF ABANDONED WORKINGS IN COAL SEAMS

REPÉRAGE DE CHANTIERS ABANDONNÉS DANS DES EXPLOITATIONS DE CHARBON

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Abstract

Coal mining has gone on in many parts of Western Europe and North America frequently for 200 years or more. Consequently in many urban areas there are abandoned workings at shallow depth which often are unrecorded. These may present a potential hazard when such areas are redeveloped.

Investigation of abandoned coal mine workings is no easy task and requires some knowledge of past methods of mineral exploitation. Such an investigation involves assessing the nature of old mine workings. The desk study will include a survey of appropriate maps, documents, records and literature, and, at times, aerial photographs.

Generally speaking the usual methods of geophysical exploration have not proved very successful in revealing the layout of shallow old mine workings. However, some relatively new methods of geophysical surveying do appear to have had some success. Of these, ground probing radar would seem to offer the most potential.

The location of old workings has generally been carried out by exploratory drilling. Workings may be examined by using borehole camera or closed circuit television, or by gaining direct access from headings or shafts.

Résumé

L'exploitation de la houille se poursuit depuis au moins deux cents ans dans plusieurs régions de l'Europe occidentale et de l'Amérique du Nord. En conséquence, il existe dans les alentours de beaucoup de villes, des chantiers d'exploitation abandonnés et peu profonds dont souvent on ne trouve aucune mention. Il se peut que ceux-ci présentent une situation dangereuse lors de l'aménagement de telles régions.

La reconnaissance de ces chantiers abandonnés est assez difficile et elle nécessite pas mal de connaissances sur les anciennes méthodes d'exploitation minérale.

En faisant une telle reconnaissance, il faut estimer la nature des chantiers anciens. Le travail en bureau doit comprendre un examen attentif de tous les documents nécessaires: plans, registres, et parfois photographies aériennes.

En général les méthodes habituelles d'exploration géophysique n'ont pas bien réussi à découvrir la disposition des chantiers anciens peu profonds.

Cependant il paraît bien que certains procédés assez récents employés par les géophysiciens aient eu du succès. Parmi ceux-ci, le radar pour sonder le terrain semble être le procédé le plus intéressant pour l'avenir.

Généralement on a découvert les anciens chantiers en effectuant de nombreux forages explorateurs. Il est possible d'examiner les chantiers en employant des appareils photographiques spéciaux ou la télévision à circuit fermé, ou en se procurant l'accès direct par les galeries d'avancement ou les puits.

1. Introduction

Subsidence at the surface can be regarded as ground movement which takes place due to the extraction of mineral resources. It is an inevitable consequence of mining activities and reflects the movements which occur in the mined out area. Unfortunately subsidence can and does have serious effects on surface structures, services and communications, can be responsible for flooding, can lead to the sterilization of land or call for extensive remedial measures or special constructional design in site development.

Old abandoned coal workings occur at shallow depth beneath the surface of many urban areas in Western Europe and North America. Indeed the presence of coal was one of the major reasons for the urban development in the first instance. Because many of these old workings were unrecorded they can represent a potential hazard to those engaged in subsequent redevelopment since such workings may give rise to subsidence problems. Furthermore the detection of unrecorded abandoned workings frequently has not been very successful. Even if records exist, they often are inaccurate.

2. Resume of past working methods

In the United Kingdom coal mining began to be carried out on a significant scale in the thirteenth century. Drifts and adits into shallow workings were usually
situated at the base of quarries and open pits or along the coal outcrops in hilly country. The workings extended as far as natural drainage and ventilation permitted.

However, by the fourteenth century outcrop workings had largely given way to bell pits. The shafts of bell pits rarely exceeded 12.2 m in depth and their diameter was usually about 1.3 m. They are, therefore, a feature of coalfield areas where the drift cover is thin. Extraction was carried on around the shaft until such times as roof support became impossible, another shaft was then sunk nearby. Hence, where such mining went on, the number of bell pits may be very numerous (Figure 1). If bell pits were backfilled, then the state of compaction of the fill is generally unsatisfactory.

Where a coal seam occurred at more than about 7 m below the surface, bell pit mining tended to be replaced by headings which radiated into the coal seam for short distances around the shaft. The pillars of coal between the headings generally represented the only type of support to the overlying strata. The layout of a mine was unplanned and simply consisted of a complex of interconnected headings. Hence the support pillars were irregular in shape and size.

Increased demand for coal in the sixteenth century led to the development of the pillar and stall method of extraction. Underground workings were shallow and not extensive, for example, they rarely penetrated more than 40 m from the shaft. Indeed, when such limits were reached, it was usually less costly to abandon a pit and sink another shaft nearby. Workings extending 200 m from the shaft were exceptional even at the end of the seventeenth century, the shaft itself usually being less than 60 m deep (see Bell, 1979).

In the pillar and stall method of working, pillars are left to support the roof thus they have to sustain the redistributed weight of the overburden which means that they and the rocks immediately above and below are subjected to added compression (Figure 2). In very

\[
R = \frac{2ab + b^2}{(a + b)^2}
\]

According to Wardell and Wood (1965) determination of the loading on pillars is best approximated by averaging the load on a given pillar due to the weight of strata above. The latter is equal to the weight of the column of strata over an area equal to \((a + b)^2\). It is assumed that the load acts vertically and is uniformly distributed over the cross sectional area of the pillar. It can be shown that the average loading \(\langle \sigma \rangle \) on a pillar can be obtained from:

\[
\sigma = \frac{Z}{1 - r}
\]

where \(Z\) is the depth. (A summary of other expressions which can be used for determining the stress on pillars is given in Bell F G. Foundation Engineering in Difficult Ground, Butterworths, London, p. 326-327, 1981)