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SOME NOTES ON THE DANGERS, LOCATION AND TREATMENT OF OLD MINESHAFTS IN PART OF THE COALBROOKDALE COALFIELD, TELFORD NEW TOWN, SHROPSHIRE.

By Ivor J. Brown.

A ‘shaft’ is taken to mean any vertical or near vertical excavation in the ground permitting access to the sub–strata. In the Coalbrookdale area shafts are normally circular with diameters from 1 m to 5m and depths varying from a few metres to over 400m.

Number of Shafts – for all purposes old wells are treated exactly the same as mine shafts since many mines became ‘wells’ as they flooded after mineral working had ceased. Similarly some shafts sunk for water found good seams of mineral and so were converted into mines. Over 2,500 probable shaft positions in the New Town area have been collated from a search of old records and plans and from experience it seems likely that up to 4,000 may actually exist. The remaining shafts will be found from further research, during opencast mining or other developments.

Hazards due to Shafts.

1. Open Shafts, persons or livestock falling down.

2. Covered shafts, sudden failure of cover either before, during or many years after development has taken place.

3. Back–filled shafts, many are only partly back–filled and fill collapse can occur at any time. In addition because the fill is often of the same material as the surrounding material they are difficult to identify.

Hazards common to the above:–

(a) any shaft can ‘crater’ or run–in around the top in a funnel shape. This may be caused by side–wall collapse and craters formed can be up to 12m across.

(b) ‘damp’, obnoxious, toxic or inflammable gases can come up shafts from the underground workings. These can accumulate in the shafts, under the covers or even in cellars or foundations in the vicinity of the shaft.

Reasons for Constructing Shafts.

1. Shafts associated with mineral workings – the great majority fall into this category. These shafts exist in all the areas in which the economic minerals, coal, ironstone, fireclay, brick and tile clays and limestone are present.

2. Trial or Prospecting Shafts – are found mainly in areas outside the localities where economic minerals are known to be present, for example the owner of Buildwas Park is known to have sunk at least ten and the owner of Hadley Park at least two shafts in an attempt to ‘get in’ on the mineral extraction boom of the 19th century. They were to be disappointed. Other trial shafts are within the mineral–bearing area

and were abandoned for some reason before reaching mineral. Some of these shafts are quit e large, two near the recently closed Kemberton Colliery are known to be about 5m diameter and were stopped when they hit 'running sand', others were stopped if they hit a geological fault or large quantities of water.

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3. Wells – are found both inside and outside the mineral bearing area, in both rural and urban areas. Wells are more numerous here than in most other localities because it is a water–shed area with few natural ponds and the inter–connection between old mine workings serves as a drain. Some of these wells are large and deep e.g. one at Wellington is known to be 2m dia. and over 21 m deep. Another at Sutton Hill is 2.2m dia.

4. Ventilation and access shafts – have and still do form a major part of any tunnelling project. The Stirchley tunnel on the Shropshire Canal had three shafts, two of the Coalbrookdale Canal shafts at Brierley Hill were 36m deep while the Dawley Drainage Level (or sough) had eleven shafts. The Corporation has just constructed four shafts as part of a 1000m sewer contract.

Shaft Incidents and Ownership

1. Former methods of making shafts "safe" – were unsatisfactory and included:–

(a) fencing off with brick walls, iron railings or barbed wire, all deteriorate rapidly, and are no protection against 'cratering'.

(b) construction of a 'brick dome' or 'beehive', this does give cover to the shaft and the shape gives some support to the shaft walls reducing chance of cratering.

(c) fixing a cover over the shaft at the surface or often part–way down and then back–filling over the top. This is dangerous as there is no surface evidence of such a covered shaft and the cover may collapse unexpectedly at any time.

(d) 'filling in' with local material or refuse. This is also dangerous since it is not possible to determine the completeness of the filling at the time, especially if water is present. Also water movement at the foot of the shaft can cause the whole fill column to collapse suddenly.

2. Shaft incidents – attract immediate public reaction. The shaft is the only part of an underground working which the public can actually see and there is always something frightening about the subterranean world to the layman. In addition such incidents usually occur suddenly and therefore evoke immediate reaction.

In the last two years eleven shaft incidents have been reported in the Press within the Coalbrookdale Coalfield. Only about half were in the New Town area and none of the shafts involved were in Corporation ownership. These included:–

(a) 'Dangerous' open shafts reported – 4 incidents.
(b) Animals falling down shafts – 3 but at least one was malicious.
(c) Shafts opening up unexpectedly during development – 2.
(d) Un–stabilised shafts found after development – 2.

3. Ownership of Shafts – The following is only a general interpretation each situation has to be considered on its own merits.

(a) Old 'coal–mine' shafts, including most ironstone and fireclay mine shafts since these minerals were usually worked at the same time are directly the responsibility of the N.C.B. except where:–

(i) they are alienated under 1938 Act as at Lightmoor;

(ii) the surface land–owners has had Title for 100 years of more of the land or where it is accepted that shafts have merged into the freehold or;

(iii) the shafts have been legally conveyed to another party, the other party providing the N.C.B. with an indemnity. The shafts on land owned by the Corporation come into the latter category.

(b) Shafts associated with the working of minerals other than coal are 'owned' by the owner of the surface freehold and the person or organisation having the right to work that mine.

(c) Wells are owned by the owner of the surface freehold.

(d) Other shafts are generally as for wells except where the owner of the tunnel has retained the Title and can be traced.

The Location of Old Shafts

1. Geology of the area – A knowledge of the geology of a particular site permits an initial assessment of the number and depth of shafts likely to be present. It also permits the documentary search to be modified accordingly, e.g. the N.C.B. have virtually no records of any shafts north of the Boundary Fault. The geological outline and a few probable shaft locations can be obtained from the publications of the Institute of Geological Sciences.

2. Documentary Search – When investigating a particular site for the presence of mineshafts the following documents are routinely searched.

(a) Ordnance Survey Maps including the earlier editions on the 1:2500 scale (1873/84 Ed., 1899/1902 Ed., and 1924/37 Ed) and occasionally the earliest editions on the '1 in. to 1 mile' scale (1830/1842). The early 1:2500 sheets are particularly useful for locating wells.

(b) Geological Survey Publications. This includes the Old and New Series, the accompanying Memoir and the Special Reports on Economic Minerals.

(c) Mine Plans. Abandonment mine plans are kept on behalf of the Inspectorate by the National Coal Board (mines of coal and predominantly coal) and the Mining Record Office, London (for other mines). Other plans remain in the N.C.B. collection, in local archives, the offices of Consultants and in private hands. Shaft locations are also shown on Title Plans, Estate Plans and Railway Survey Plans.

From the known plans the N.C.B. has produced for the coal mining area a set of plans on a 1:2500 scale showing all recorded mine shafts (this is a continuation of a project first began by the Coal Commission). These plans do not necessarily show shafts for the working of minerals other than coal and are not purported to be complete. Additional plans and records are becoming available all the time and shaft positions from these, and actual shafts located are added to the records as soon as they are identified.

The N.C.B. has also prepared plans to the 1:10560 scale showing all recorded underground workings in the individual seams of coal and ironstone. These also show a large number of shafts.

(d) Aerial photographs and 1:500 plans based on these are commissioned by the Corporation.

(e) Other Papers, Reports and Documents available in libraries and private hands.

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3. Local Information – Information on mine shafts locations can also be obtained from press reports, local farmers, landowners and other individuals. Land Title deeds and mineral valuers reports can also be useful.

4. Visual Examination of Site – All recorded positions are examined together with other positions showing the following features.

(a) mounds of spoil .
(b) rough permanent pasture.
(c) broken fence or evidence of small enclosure.
(d) hollows or funnel shaped craters.
(e) circle of bricks or other brickwork.
(f) hollow with horse gin ‘circle’ or engine house remains alongside.
(g) localised areas of nettles, hawthorn or holly bushes.
(h) discoloured areas of soil in ploughed fields.
(i) iron plates, concrete square, brick domes or beehives.
(j) circular ponds or damp areas.

NOTE: It is easy to mistake other features for mineshafts, e.g. bases of kiln shafts, circles of bricks can be chimney bases or the footings of haystack boilers, iron plates can cover manholes, cesspits or storage tanks. Funnel shaped ‘craters’ can be the position of the original engine house, the spoil heap and shafts having been built up around it as at the Spout Mound.

5. Excavations to locate Mineshafts. – Some mineshaft positions are immediately obvious at the surface, others show characteristic features although no definite evidence while a third category are not evident at all. When characteristic features are present but no definite evidence, and where the shaft is believed to be of small diameter, a top–soil strip can be carried out using a dozer with blade or scraper box. Circular areas of different materials, soft spots and brickwork may indicate the shaft position.

If there is no evidence of shaft the probable position of the centre of the shaft is pegged and two further pegs are placed equi–distance from this, say 5 metres, one on each side and all three in a line. A back–acter type excavator then cuts a trench through the middle of the shaft but commencing some distance from probable centre. If no brickwork or other evidence of the shaft becomes apparent a further parallel trench is cut about one metre away and this procedure is repeated until about five trenches have been cut. If no evidence has been found the whole sequence is repeated at right angles to the first.

6. Probe drilling for shafts – If excavation fails to locate the shaft or if excavation is for some reason inadvisable, probe–drilling to rock–head is necessary. The area around the shaft is marked out in a close–grid pattern, about 1 .5m spacing, and holes are put down at each intersection. The drill holes are put down to rockhead and when no rockhead is found in a hole at the average depth that it is present in the other holes, or if there is a difference in the strata passed through, this is assumed to be the shaft position pending further investigation. The rig used for probe–drilling must always be on a substantial scaffold to minimise the risks due to cratering.

7. Geophysical Techniques – Both the magnetic and electrical resistivity methods have been used in an attempt not only to give a wider coverage during shaft location, but also to reduce costs of investigation. The results were not conclusive and it is unlikely that they will be used in anything but the most exceptional case in the future.

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Only occasionally are unfilled shafts located which are not already visible at the surface. Most shafts appear to be backfilled but the completeness of the backfill can only be checked by drilling through the backfill to the original base of the shaft.

If the shaft cannot be located at or near the recorded position the source of the information is double checked and its reliability assessed. Usually the source is given the benefit of the doubt and the position recorded is capped off below surface level and it may then be fenced with permanent steel railings. The proposed development is then designed to avoid this railed off area.

The Treatment of Mineshafts.

Abandoned shafts and wells are normally found in one of the following conditions:–

(i) Unfilled shafts containing very little water.
(ii) Unfilled but containing water.
(iii) Backfilled.

An apparently unfilled shaft may, of course, have been partly backfilled or, conversely an apparently backfilled shaft may be open beneath an intermediate staging.

Before a shaft is filled the Local River Authority should be informed (Water Resources Act 1963, Section 72) although they are normally only concerned with the discharge of trade effluent and poisons, noxious or polluting matter into underground workings. The materials used for backfilling and stabilising are chosen to be as inert as possible. Consideration must also be given to the affect of stopping off underground water courses especially in potential landslip areas.

(i) Unfilled shafts containing very little water.

An examination should be made of the shaft for landings and other obstructions. Only rarely is it possible to enter an old shaft safely so that examination is limited to shining lights and lowering plumb–lines. It is not safe to drop stones or burning paper down shafts likely to be ‘gassy’.

While it is recommended, it is not often possible to seal off intermediate landings or to remove shaft obstructions, other than by using a drop–ball in non–gassy mines. Before filling, any cables, ropes or pipes hanging in the shaft should be removed, they should not be allowed to fall down it since this could cause an obstruction. If explosive gas is likely to be present tests can be made using methanometer and anti–static suction hose. If present, the shaft can either be ventilated or filled using a short conveyer and fine clay materials. Other shafts normally have hard–core placed at base and intermediate insets, clay seals, interposed in the shaft itself with the remaining sections of shaft being filled using general filling materials.

Materials liable to spontaneous combustion, decomposition or to contaminate water must not be used.

The weight, type and volume of each load should be recorded and regular tests made of depths to check progress and ensure complete filling. No naked flame should be permitted in the vicinity of a shaft during filling. Some settlement of fill can be anticipated and the top should be heaped, then fenced for a while. After this it should be plugged or capped as described later.

(ii) Unfilled shafts containing water can either be pumped dry before filling, or if this is impossible or inadvisable, can be filled by lowering hardcore. Any displaced water should be removed from the shaft top area by proper drains. Stabilisation can be completed either by starting from above water–level with ordinary grouts or by using hydraulic cement grouts.

(iii) Backfilled shafts may be plugged, capped or fully stabilised by drilling, grouting and capping off or treated by any combination of these processes. A plug has been defined as a mass concrete slab placed within a shaft or just over a shaft either at firm ground level or rock head level. A cap has been defined as a reinforced concrete slab placed over the top of the shaft at existing ground level or at the level to which the shaft is cut down. Obviously the best position for a cap is at rockhead so that the chances of tilting or running–in under the sides are reduced.

Generally:–

(a) if a shaft is of small diameter, shallow depth will be more than the 10m from a structure, it can be plugged.

(b) if shaft is of large or medium diameter, considerable depth and will be more than 10m from a structure it can be capped, usually with a cap having a lockable inspection cover or sandfilled grout–hole.

(c) if shaft is known to have been properly filled or proved to be so filled by drilling but within 10m of a structure the shaft should be capped.

(d) if shaft backfill is suspected of being of poor, unknown or inconsistent quality and is within 10m of a structure it must be fully stabilised using drilling, infilling and grouting and finally capped off.

(e) if a recorded shaft cannot be located no structure should be placed within 10m of recorded position but a cap should be fixed at rockhead or a large plug at base of excavation, if rockhead cannot be reached, the excavation then being backfilled and permanent fencing affixed.

A typical cap for a 2.5m dia. shaft might be 5.0m square and 0.5m thick. For other sizes of shaft the dimension could be increased or reduced accordingly. Plugs are often about twice the shaft diameter in diameter at the top, tapering slightly downwards and 0.6 of the shaft diameter in thickness.

<u>Full shaft stabilisation involves drilling, infilling and grouting</u>.
Methods of drilling for shaft stabilisation includes:–

(i) drilling with a bit followed by casing in the conventional manner, or

(ii) drilling with the casing fitted with a cutting edge and then reaming out by drilling down inside the casing or

(iii) using drill only with no casing. In this case grouting is done by either dropping an explosive charge down inside the rods to blast off the bit or by grouting through the bit itself.

Difficulties – experiences during drilling includes:–

(a) difficulty in obtaining evidence that drilling has reached ‘solid’,
(b) difficulty in holding casing if shaft fill collapses,
(c) obstructions in shaft,
(d) deflection of drill,
(e) difficulty in ensuring explosive charge gets to bottom of rods,
(f) material falling behind drill bit collar prevents withdrawal,
(g) disturbance of fill and vibration in one shaft can cause fill collapse in adjacent shafts. Care should be taken to ensure that drilling does not ignite ‘gas’.

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Methods of infilling voids:–

(a) large voids (30m vertical is not unusual) can be filled by dropping aggregate, concrete or grout through rods or casing. ‘pea gravel’ has been extensively used but takes time to drop in water and if pea gravel level overtakes rod withdrawal it can fasten rods.

(b) small voids and, increasingly, medium to large voids are filled by dropping grout or concrete.

Grouting up is completed using:– either pre–packed materials individually mixed or batch mixed, sometimes gravity or ICMI–pressure is used initially (up to 40 psi) often followed by high–pressure (up to 100 psi).

Problems encountered have been overcome by:–

(a) using a plastic tube rather than the rods for passing grout
(b) frequent washing out or, more preferably, continuous grouting
(c) using rapid hardening cements for sealing off insets.
(d) preventing outflow of grout up annulas by reducing bit/rod size ratio withdrawing rods 3m at a time allowing pressure to build up slowly and ‘packing’ the annulas at surface.

The grout most commonly used nowadays is a 9:1 PFA/cement mix. Over a number of shafts the grout take can vary between 10 and 30% of original volume.

As mentioned previously stabilisation is completed by capping or plugging dependant upon location of structures relative to the shaft.

Footnote:
The importance of locating and treating all disused shafts is clearly shown by the following examples:–

(1) About 1900 an unsuspected mineshaft opened up under Burslem Park Lake and swallowed up, it was reported, all the water, fish, ducks and a number of empty rowing boats.

(2) In April 1945 a shaft opened up in the railway sidings at Abram, near Wigan, and a train of 13 railway wagons and locomotive went down it. The train and driver have not been recovered.

(3) In 1953 at Patricroft, Yorkshire, three houses collapsed into an unsuspected ventilation shaft and five persons were killed.

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