The use of micro-excavators on archaeological sites: a review

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DURING THE RECENT excavations on the Roman villa at Beddington, near Croydon, Surrey, it was necessary to remove 50cm (20in) depth of overburden from an area, but because of the nature of the surrounding landscape, it was impossible to drive a JCB or similar excavator into the area without crossing and badly damaging other areas already under excavation. Consequently, a 'Powerfab 125 Micro-Excavator' was hired to perform this task, and the opportunity was taken to assess the performance of this machine; this assessment is summarised here.

The Machine

The machine consists of a digging arm worked by a hydraulic system powered by a 5hp petrol engine. It is fitted with two rigid legs in the front, hinged so that they can either point forward or be splayed sideways, and a hydraulic outrigger at the rear. When in use, the machine rests on the front legs, and the outrigger at the rear is lowered

to raise the wheels off the ground. To move the machine when in use, the outrigger is raised so that the wheels rest on the ground, and the digging arm is used to raise the front legs off the ground and push or pull the machine in the desired direction. For moving the machine short distances on site, the front bucket can be rested on a trolley and the machine manhandled as required (see Fig. 1). On a smooth flat surface such as a concrete path, the machine can be easily pulled by one person, but over rough or sloping ground a team of three or four people is required. For long distances the machine can be towed on a trailer or carried in a transit van. The machine can be fitted with an 8 inch, 13 inch or 16 inch wide bucket (the 16 inch wide bucket was used at Beddington).

Performance

The machine runs on two-star petrol and at Beddington used between 1 and $1\frac{1}{2}$ gallons during



Fig 1: The micro-excavator being moved on site.



Fig. 2: The micro-excavator in use.

an 8-hour working day, depending on the rate at which the machine was worked. Four people took a turn at driving the machine, and it was found that it took an average of 30 minutes to master the controls. With the same driver using the machine for several days in succession, it was found that it took about a day to become proficient in controlling the machine, but marginal increases in performance were achieved in the following four days, after which no further increase in the efficiency of the driver and machine could be achieved.

The machine was hired for 14 days on a 'time out' rather than 'time used' basis at a cost of £80 plus VAT per seven days with an extra transport charge to and from the site. The total hire cost of the machine, trolley and transport (excluding fuel) was £200. Because the basis of the hire was 'time out,' no money was refunded for time lost due to breakdowns, and because no fitter from the hire company was available at weekends, an unnecessary amount of time was lost due to a breakdown on a Saturday morning which could not be repaired until the following Monday. Nevertheless, only three days work was lost resulting from two breakdowns (due to an airlock in the hydraulic system and a leaking hydraulic hose), and so long as the hire company is efficient with the maintenance and repairs, it would seem reasonable to expect at least five days work out of every seven for which the machine is hired.

At Beddington the machine was largely used to remove an overburden consisting of soft silty soil, mixed in places with large gravel and flint pebbles. In some areas it was used to remove compacted gravel that had been laid down as hard-core for a rough road (see Fig. 2), and the performance of the machine in these areas was reduced because the teeth of the bucket had to be initially used to break up the compacted gravel. Working at peak efficiency, the machine could excavate approximately 30cu m (40 cu yds) of soil in an 8-hour working day (compared with approximately 8 cu m (10 cu yds) of soil removed in the same period by a driver learning to use the machine for the first time). The machine dumped the excavated material into wheelbarrows, and a team of between two and six people was needed to push the wheelbarrows (depending on the distance of the spoil heap from the machine). The efficiency of the machine could undoubtedly be improved by using it in conjunction with two dumper trucks, but the nature of the terrain at Beddington precluded this.

Advantages and Disadvantages

Because the machine is hired out on a self-drive basis, it is possible to have a driver who knows the nature of the site very well, which gives a much greater degree of control over the work than with a hired driver. The machine can be manoeuvred through narrow spaces (with the front legs folded inwards it has a minimum width of 71cm; 28in), and being relatively light in weight it can be used in areas inaccessible to larger machines. For small and/or delicate excavation jobs, and on excavations with a small budget but a sufficient labour force, this machine would prove much more economical to hire than a JCB, particularly since many plant hire firms are reluctant to hire out a machine for only one or two days.

The disadvantages of the machine must also be considered, the major one of which is that the machine uses the digging arm to push or pull itself along while it is in use. The weight of the machine on the bucket could compact archaeological layers, and the teeth on the bucket could cut through the layers. In practice it was found that there was no noticeable compaction, as would be the case with a JCB, although there was a danger of the teeth on the bucket penetrating the surface by 5-8cm (2-3in) if insufficient topsoil was left as a protection against this. The teeth on the bucket cannot be removed but the underside of the teeth and the underside of the bucket are in the same plane (the teeth are not offset as on some machines), and so with care it is possible to cut a smooth surface without leaving ridges made by the teeth.

With the front legs in the splayed position, the machine is very stable in use, but with the legs in the forward position, the machine can very easily topple over sideways. In most situations, however, there is ample room to have the legs in the splayed position and so the problem rarely arises.

Another disadvantage is that the digging arm is positioned so that the bucket can undermine the front legs. This is not serious if only a small depth of soil is being removed, but if a deep trench is being dug (the machine can excavate up to a depth of 1.7m; $5\frac{1}{2}$ ft), there is a real danger of a careless driver undermining the front legs to such an extent that the machine and driver could fall into the trench. One minor design fault is that the position of the driver's seat cannot be adjusted, and so a driver with even slightly longer than average legs has to adopt an uncomfortable position in order to operate the controls.

Despite these disadvantages, many of which can be overcome or avoided by using the machine carefully, this machine is a very useful addition to the range of mechanical excavators available for use by archaeologists; on excavations where the only alternative is to remove the overburden by hand, the use of the micro-excavator could greatly speed up a hard and boring task for a relatively small amount of money.

The "Powerfab 125 micro-excavator" is manufactured by Powerfab Ltd, Unit 20 and No. 7 factory, Tafarnaubach Industrial Estate, Tredegar, Gwent.

Local Societies - amendments

THE SIXTH SET of amendments to the list of local societies (Vol **3**, No. 12, 318-9) is as follows:

Beddington Carshalton & Wallington Achaeological Society; Sec. Mrs J. Clark, 7 Beech House, 57 Woodcote Road, Wallington, Surrey.

Egham-by-Runnymade Historical Society; Sec. R. Wykes, 1 The Crescent, Egham, Surrey.

Enfield Archaeological Society; Sec. Mr J Stevens, 3 Scarborough Road, Edmonton, London, N.9.

Hendon & District Archaeological Society; Sec. Mr Brian Wrigley, The Mermaid, 21 Woodcroft Avenue, London N.W.7 2AA.

Orpington & District Archaeological Society; See Miss Miss Carol Springall, 18 Mickleham Road, St. Paul's Cray, Orpington, Kent, BR5 2RL.

Surrey Archaeological Society; Secs. John & Marian

Leveson Gower, 28 Gingers Close, Cranleigh, Surrey, GU6 7JL.

The Wimbledon Society (formerly The John Evelyn Society); Sec. Mrs R. Colman, 4 Helme Close, Lake Road, SW19 7EB.

Change of address:

Wembley Historical Society; Sec. T.A.C. Lomas, 43 Jordan Road, Perivale, UB6 7BJ.

West London Archaeological Field Group; 273A High Street, Brentford.

Correction:

Pinner Local History Society; Sec. Mrs. C. Baker (not Haker), 10 Pinner Green, Pinner.

Stanmore & Harrow Historical Society; Sec. Mrs. W. E. Cunningham (not Cunnington), 71 Barn Rise, Wembley Park, HA9 9NH.