Recording Test

In advance of the 2012 excavation on the designated wreck site of *HMS Colossus* an appraisal of finds positioning methods was undertaken. In any underwater archaeological excavation, one of the most time consuming elements of the recording system is finds positioning. The 2001 excavation on the site used offset measurements from a datum installed along the edge of the excavated trench to position finds. However, it was felt that a more accurate method of recording finds positions should be investigated for the 2012 excavation. Accordingly, an offset frame sliding along a 6m scaffold pole was devised (hereafter referred to as frame offset).

In order to test the newly constructed frame offset device, a comparative 'dry land' trial was devised. This trial compared fixing six simulated finds positions using three different methods – Direct Survey Measurements (DSM), traditional offset measurements and the newly constructed offset frame.

Layout

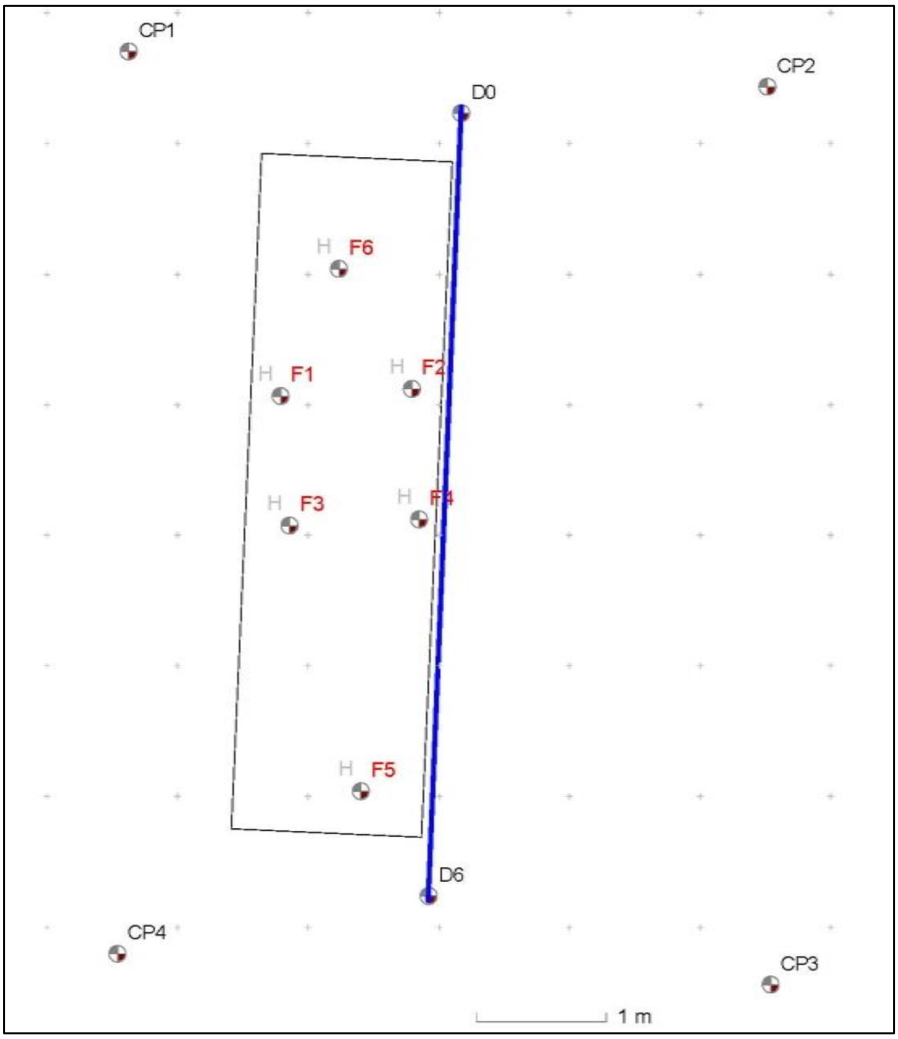

Fig 1

The layout of the finds positioning trial. The simulated finds are numbered F1 to F6

Six simulated finds positions were represented by steel rods (10mm diameter x 0.50m long) driven into the sand. These were numbered F1 to F6. F1 to F4 were arranged at the corners of a 1m square, while F5 and F6 were placed exactly 4m apart. These were within the outline of a 'trench' with the same dimensions as the intended trench on the 2012 *Colossus* excavation. Four control points were positioned around the 'trench' as shown in fig 1, and were marked by means of steel pins driven into the sand. The relative heights of the tops of the steel pins were established using a dumpy level. The six metre scaffold pole datum was fixed to vertical steel stanchions along the edge of the excavation trench and levelled using a spirit level (the system which will be used underwater). The relative height of each end of the pole was then measured using the dumpy level. This showed that the datum pole end heights differed by 13mm. Although it will probably never be possible to get the pole exactly level by this method, the trial has highlighted the need for greater care when setting the pole on site.

Fig 2

Levelling using the dumpy level

DSM

The relative positions of the four control points CP1 to CP4 were fixed using Site Recorder. A measurement was then taken from each of the six finds pins to the control points – thus 24 measurements were required to record the six finds. The heights of the finds were fixed using the dumpy level (this would normally be done using the diver's depth gauge or computer underwater).The DSM recording took two people seven minutes to complete (excluding depth/height measurements). On site, this would take slightly longer as depth readings would need to be recorded.

Traditional Offset

The traditional offsets were measured from the horizontal 6m scaffold pole positioned along the edge of the trench. The offset measurements were taken using a normal 30m tape and the depth measurements using a plastic folding 1m rule (the sort sold by NAS). The traditional offset recording of six 'finds' took four minutes to be completed by two people. Three measurements were recorded for each 'find': distance along the datum pole, offset distance and depth below datum pole. All readings were taken to the nearest centimetre.

Frame Offset

The frame offset device consists of a stainless steel set square which slides along the 6m scaffold pole datum. It also has an adjustable rod attached to measure depths. Scales have been attached to the frame using epoxy adhesive. The six 'finds' positions were measured in two minutes using this device. Three measurements were recorded to fix each 'find': these are termed datum, offset and down.

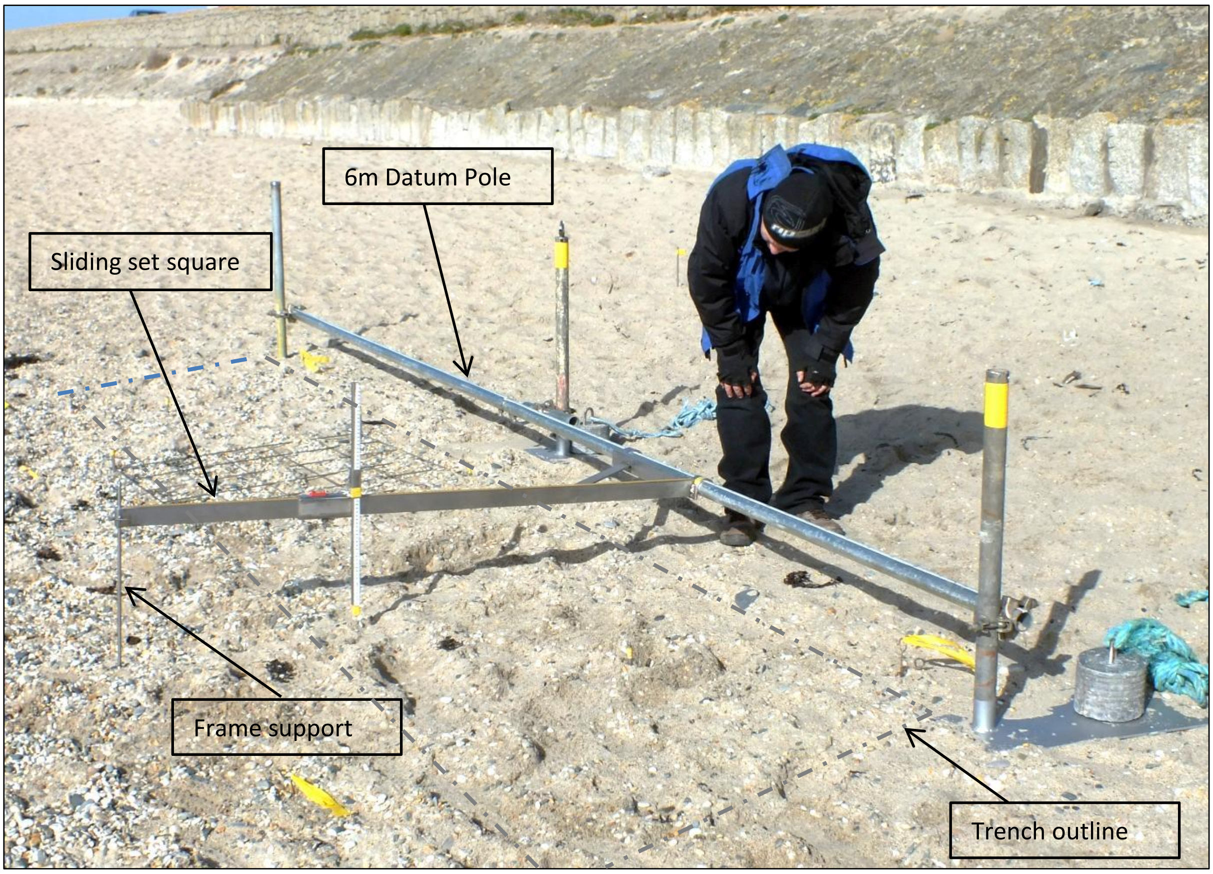

Fig 3 The frame offset device for measuring finds positions seen here during the recording trials on the beach.

The offset frame is fitted with a spirit level to allow it to be set horizontally (using the adjustable frame support leg) - see fig 3 above. Measurements are read directly from the device as tapes have been fixed to the frame and scaffold pole using epoxy resin (see fig 4 below). All readings were taken to the nearest centimetre.

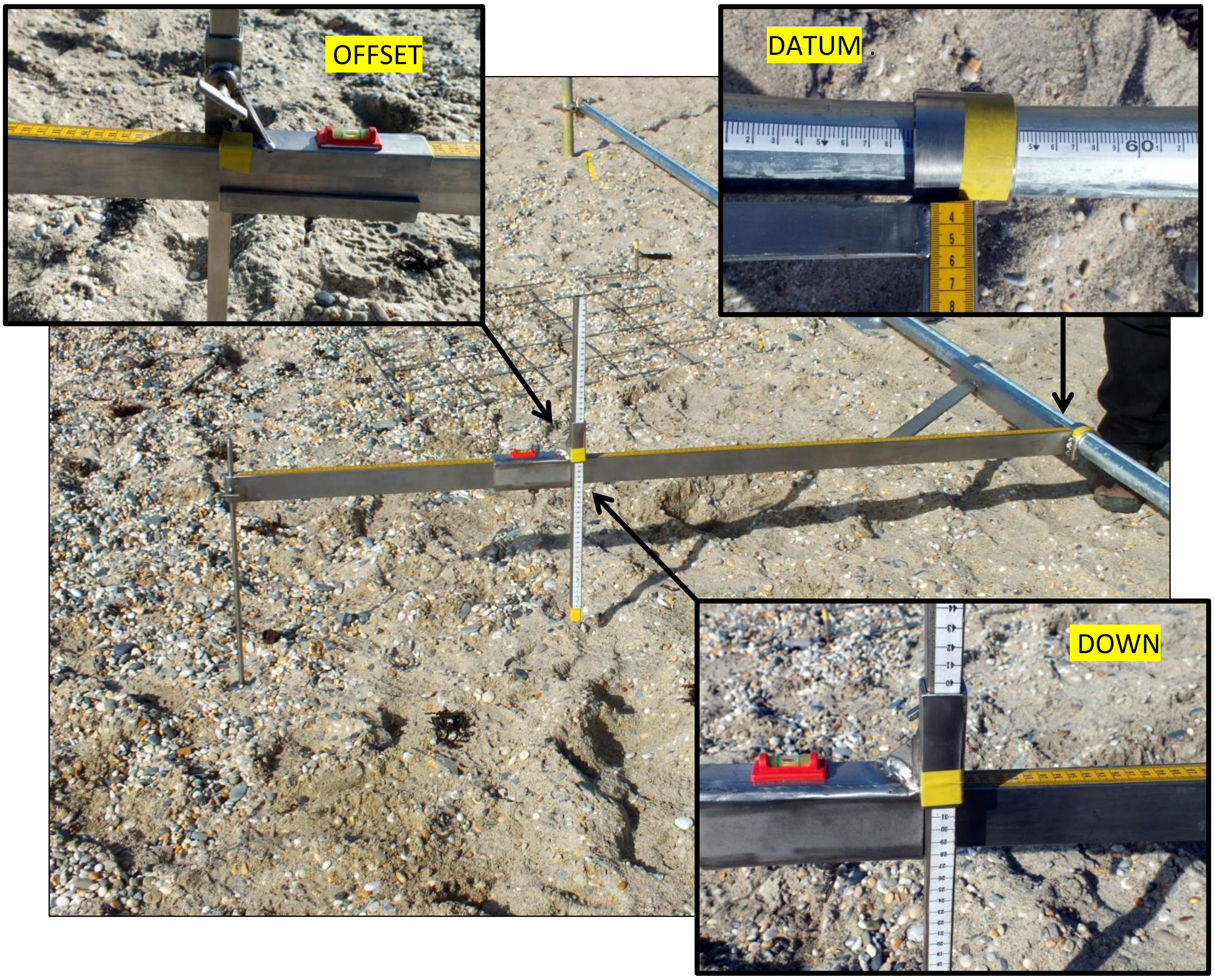

Fig 4 Details of the recording frame showing the datum, offset and down measuring points. In each case the point to read the measurement from is marked with yellow tape.

Recording errors

One of the perennial problems in underwater surveying is recording errors. It is interesting to note that during the recording trials (undertaken on a sunny day on dry land) several recording errors were made. The first error was two transposed measurements made during the DSM recording (the correct measurements were taken but recorded against the wrong control point). When processing DSM survey, the Site Recorder software chose to ignore these two measurements – application of the mark one human eyeball showed that the two measurements had been transposed.

The second error occurred during the traditional offset recording and involved two measurements out by exactly one metre. This is a common error and is caused by having to look back along the tape to see how many metres along it the reading occurs (most 30m tapes are marked in centimetres – the number of metres being recorded only at the start of each metre). The error occurs when the surveyor reads forward to the next metre rather than backwards to the last metre – something to bear in mind when purchasing tapes. Errors are more difficult to catch in offset measuring than when using DSM. The offset frame uses dressmaker's fibreglass reinforced tapes – these are marked in centimetres (ie 1.45m is marked 145cm) so the surveyor only has to record exactly what is marked on the tape.

Results

The table below compares the computed depths of the six simulated finds using each of the methods trialled, compared to the measured depths using the dumpy level. Not surprisingly, the DSM measurements accord most closely with the measured heights with a mean difference of less than 1mm. The frame offset had a mean difference of 4mm while the traditional offset had a mean difference of 51mm.

Comparison of computed depths							
	Dumpy Level	**DSM**		**Frame**		**Offset**	
		Value	Diff(mm)	Value	Diff(mm)	Value	Diff(mm)
F1	1.870	1.870	0	1.87	0	1.75	57
F2	1.762	1.762	0	1.76	2	1.74	22
F3	1.891	1.891	0	1.83	11	1.82	71
F4	1.823	1.825	2	1.82	3	1.80	23
F5	1.857	1.856	1	1.85	7	1.83	27
F6	1.838	1.837	1	1.84	2	1.73	108
Mean diff (mm)			**<1**		**4**		**51**

The next table compares the computed positions for the three different recording methods of F5 and F6, which were placed exactly 4m apart on the ground. Once again the DSM recording gives the best result with only 2mm difference between the computed and actual difference. In this case the two offset recording methods have very similar results of 14mm difference (traditional offset) and 16mm difference for the frame offset.

Comparing two points a set distance apart			
	Method	Value	Diff (mm)
F5 to F6 (4.00m)	DSM	4.002	**2**
	Frame	3.984	**16**
	Offset	4.014	**14**

Finally looking at the four points (F1 to F4) which were placed at the corners of a 1m square, we compared the computed lengths for the four sides of the square as well as the diagonals. Overall the six DSM computed lengths had a mean difference from the actual lengths of 6.8mm . The frame offset gave the next best result with a mean difference of 9.8mm while the traditional offset method was significantly worse with a mean difference of 101mm.

Four points arranged at the corners of a 1m square						
	DSM		**Frame**		**Offset**	
(1.00m)	Value	Diff (mm)	Value	Diff (mm)	Value	Diff (mm)
F1 -> F2	1.013	13	1.007	7	0.982	18
F2 -> F4	1.006	6	1.004	4	1.014	14
F3 -> F4	0.995	5	1.005	5	1.118	118
F3 -> F1	0.996	4	0.984	16	1.230	230
Mean Diff (mm)		**7**		**8**		**95**
(1.414m)	Value	Diff (mm)	Value	Diff (mm)	Value	Diff (mm)
F1 -> F4	1.424	**10**	**1.401**	**13**	**1.424**	**10**
F2 -> F3	1.411	**3**	**1.428**	**14**	**1.634**	**220**
Mean Diff (mm)		**6.5**		**13.5**		**115**
Tot Mean Diff(mm)		**6.8**		**9.8**		**101**

Conclusions

It is clear from the results that the most accurate method of the three trialled is DSM survey. However, it is also the slowest of the three methods (seven minutes for the six 'finds') and also causes the most disruption to others working in the area (in this case the excavators) because of the deployment of tapes from four different directions. The offset frame constructed for the excavation proved to be the quickest in use, taking only two minutes to record the six 'finds'. The accuracy was only slightly worse than with DSM, and in practice is a great improvement on traditional (freestyle) offset recording. The traditional offset recording was clearly the least accurate of the three methods trialled and it took twice as long to record the six 'finds' as the offset frame, although it was quicker than DSM.

In consequence of the above trials, the offset frame is the method which will be used to record the finds on the Colossus excavation in 2012.

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