Object:	**Shipwreck of VOC ship Amsterdam**
Location:	**Hastings (UK)**
Period:	**21- 23- 08-2009**
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Number:	**01**
Date:	**11-09-2009**

Report "Survey of the shipwreck Amsterdam"

Summary

One of the objectives of the Dutch foundation V.O.C. Schip Amsterdam is to monitor the condition of the shipwreck. The shipwreck is known to erode but it is unknown at what rate. The wooden material of the top (at least 20 to 30cm) of all ship parts has converted into a fairly soft material.
By mounting stainless steel tags into meaningful reference points and measuring their distances, an accurate (sigma within 2cm) set of coordinates was obtained.
In future, at regular time intervals of years, the condition of the wood, the tags as well as the set of coordinates should be monitored in order to get an idea of the deterioration rate.
The operation was executed with permission of English Heritage, under supervision of Bureau Monumenten en Archeologie Amsterdam.

1. Introduction

MIM: Since the year 2000, members of the foundation Mergor in Mosam (Dutch under water archaeology) are involved in activities of the foundation V.O.C. Schip Amsterdam, concerning the wreck of the "Amsterdam" in Hastings, England.
A few times a year the tide is sufficiently low that the top part of the wreck falls dry. During these low tides there is time to do all kinds of activities on the "Amsterdam".
One of the objectives of the Dutch foundation V.O.C. Schip Amsterdam is to monitor the condition of the shipwreck. The shipwreck is known to erode but it is unknown at what rate. This report describes the proposed method to determine the rate as well as the first phase of its execution.
The operation was executed with permission of English Heritage, under supervision of Bureau Monumenten en Archeologie Amsterdam.

2. Methods

The method proposed by MiM boils down to map a series of reference points of the wreck (and pile sheet construction) at regular moments in time. These reference points need to be mounted on the best accessible and most solid parts of the wooden structure. Because of the hostile environment these points have to endure (severe erosion, corrosion and even vandalism or theft), stainless steel screws with

an identification tag were driven into the wood. Details about the construction as well as the mounting are given in Appendix 1. Once the reference points were all in place, the relative positions were determined. This was done by means of Site-surveyor, which requires to measure all the distances between the points. Details about Site – surveyor are given in Appendix 2.
In order to test another method for tagging, plastic tags used for tagging life-stock were mounted with nails. As the purpose of these tags was not for measuring their relative distance, the nails were completely driven into the wood, so any erosion of the underlying wood can be monitored easily. Details are given in Appendix 1.

3. Results

Despite the thick layer of sand on top of most of the upper wreck-parts, by manual digging the team succeeded in uncovering sufficiently well distributed points more or less suitable for mounting the screws (sufficiently. No less than 14 points (10 mainly on the bow-section of the wreck; 4 on the sheet-piles) could be selected.

The condition of the wood, after removal of a layer of mussels, was bad: the surface was brownish black and soft, as was the wood removed from the interior by drilling.

Figure 1 shows the calculated layout of all points, as well as all connecting lines. The green lines denote deviations of calculated versus measured distances of less than 2cm, whereas the red lines denote deviations less than 4cm. The average residual was 1.1cm.

Figure 2 shows the calculated lay-out, using the reference points of the wreck only, in order to get a better impression of the shape of the wreck.

Table 1 provides the coordinates of all reference points.

Introducing provisional height differences (+ 0.30m for M1, A, B, C and D) did not improve the accuracy. The remainder of the deviations is probably caused by inaccuracy of the measurements, like forces exerted on the tape or sharp bends in the path.

Besides the lay-out of the reference points, a very rough indication of the coverage of the wreck with sand as well as water depth (at low tide of course) is given.

Depths of reference points below the sand surface:
MiM07 = 18cm
MiM02 = 21cm
MiM03 = 8cm

Water depths between reference point A to B at a regular spacing of 3.5m, starting 30cm off points A and B:

A + 0.3	+3.3	+6.6	+10.2	+13.8 (B)
29cm	9cm	10cm	22cm	79cm

The plastic tags were mounted at the following locations:
- Number 85 in the bow-section near reference point MiM01.
- Number 99 in the bow-section at the far-end
- Number 82 at starbord side near MiM04
- Number 104 at port side between MiM03 and MiM07

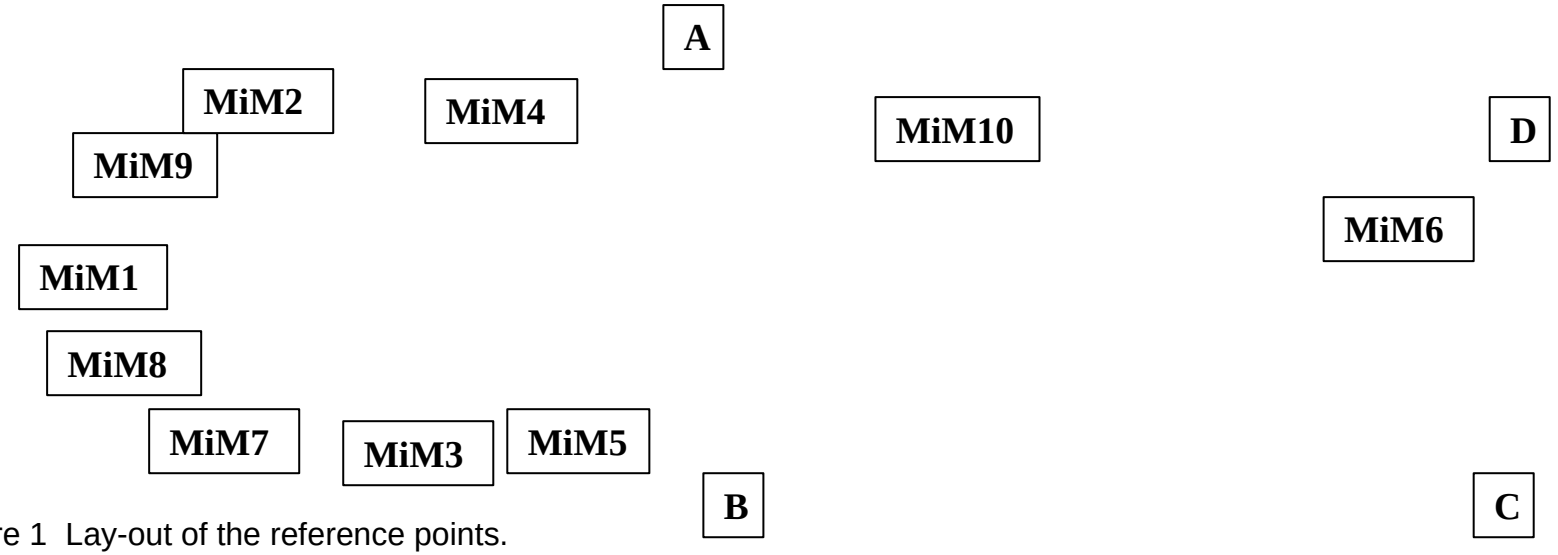

Figure 1 Lay-out of the reference points.

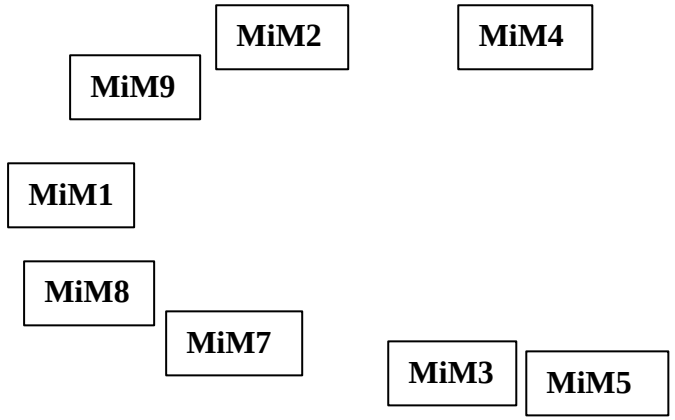

Figure 2 Lay-out of the reference points of the wreck only.

Figure 3 The locations of the yellow plastic tags.

Table 1 Calculated coordinates (m) of the reference points and their deviations. M = MiM.

Reference points	X-coordinate m	Y-coordinate m	Deviation m
A	22.63	28.41	0.01
B	23.59	14.37	0.01
C	48.15	14.22	0.01
D	48.90	25.52	0.01
M1	1.83	20.95	0.02
M2	7.17	26.07	0.02
M3	13.00	15.90	0.01
M4	14.97	26.19	0.02
M5	17.82	15.82	0.01
M6	43.55	22.42	0.01
M7	6.32	16.25	0.01
M8	3.53	18.11	0.01
M9	4.28	24.35	0.01
M10	29.25	25.41	0.01

4. Conclusions

- The wooden material of the top (at least 30cm) of all ship parts has converted into a fairly soft material.
- The measurements provided a consistent and accurate (sigma within 2cm) set of coordinates, which can be used for drawing and monitoring of the wreck.

5. Recommendations

- Monitoring the condition of the tags.
- Monitoring physical changes of the wreck by repeatedly measuring the relative distances of the reference points on a regular basis.

- Monitoring the erosion processes by checking the position of the plastic tags.

6. Acknowledgements

Special thanks for Adrian Barak (Shipwreck Museum Hastings) for showing great hospitality, offering the team shelter and drinks, Diana Derks and Marc Pennings (Mergor in Mosam) for designing and manufacturing the stainless steel screws and tags.

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Abbreviations

BMMA	Bureau Monumenten en Archeologie Amsterdam
MiM	Mergor in Mosam
EH	English Heritage
SVA	Stichting V.O.C. Schip Amsterdam

Appendix 1 Construction and mounting of tags.

The tags usually employed by MiM are ordinary tags for marking life-stock made of plastic. Under not too severe conditions (lakes and rivers), these tags last for years. The erosive condition near the shore line at Hastings is much more severe, so a construction was designed (Marc Pennings) and manufactured (Marc Pennings and Diana Derks) that should hold-out for many years. The plastic tags will be tested anyhow (see below).
The design, entirely made of stainless steel, comprises a long threaded rod with a diameter of 8mm and lengths varying between 25 and 35cm. One end of the rod has a sharp tip, the other end has a small round base-plate and a tag (with imprints), both fixed by 4 bolts. Figure 1 shows two examples. Figure 2 shows a mounted tag.

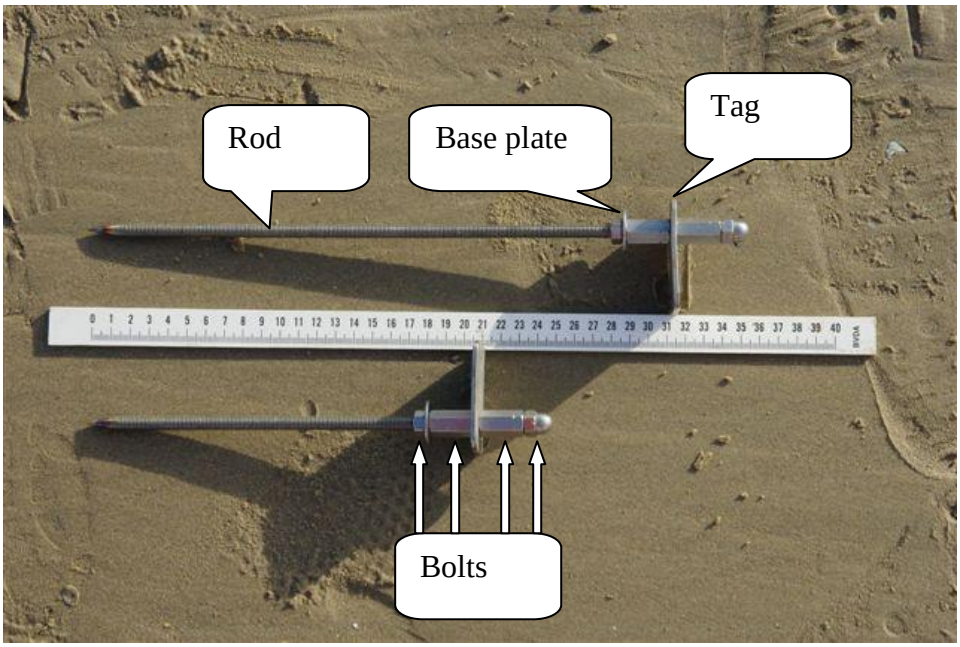

Figure 1 The tags, their parts and dimensions.

Figure 2 Tag number 4 (MiM 04) mounted in a wooden pile.

The tags were mounted manually by an elaborate screw action (Figure 3). To prevent the wood from splitting, holes of 6mm were drilled over the entirely required depth (length of the threaded rod). The rods were driven in up to the base plate. This plate is the reference point for the present outer surface of the wood. In future the rate at which the wood erodes can be monitored relative to this base plate.

Figure 3 Mounting the tag manually.

For the experiment with the plastic tags, the plastic tags (yellow with black painted number) were mounted with 16cm long threaded galvanized nails, hamered into the wood.

Figure 4 The yellow plastic tag.

Appendix 2 DSM, Webit and Site surveyor.

DSM, Webit and Site surveyor are all versions of techniques to map chosen locations by determining their relative two- or three-dimensional distribution. The techniques all use the measured distances between all locations and calculates the coordinates that fit the measured data best. The program uses least-square-type algorithms for these calculations. The data input consists of provisional coordinates of all locations (in three dimensions). The x- and y-coordinates are rough guesses, the z-coordinate is really measured. When, as in a lot of cases, the locations all lie more or less in a plane, the calculated coordinates will be fairly accurate. The z-coordinate (depth) is put in as zero. When the locations deviate seriously from the plane, height (depth) can be added.
It should be bore in mind that these coordinates are relative to this plane !

The accuracy of the calculated coordinates (vectors) depends in most cases on the accuracy of the measured distances, which suffers of spread due to variation of force exerted on the tape or a bend path between two reference points.

Table 2 All input data.
M = MiM

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	A	B	C	D
M1		7.37	12.23	14.14	16.82	41.77	6.49	3.32	4.22	27.77	22.07	22.7	46.82	47.3
M2	7.37		11.71	7.78	14.8	36.56	9.85	8.75	3.37	22.07	15.65	20.2	42.65	41.75
M3	12.23	11.71		10.51	4.82	31.24	6.69	9.73	12.13	18.82	15.78	10.69	35.17	37.15
M4	14.14	7.78	10.51		10.74	28.83	13.15	14.02	10.86	14.29	7.97	14.6	35.28	33.94
M5	16.82	14.8	4.82	10.74		26.56	11.49	14.48	16	14.92	13.48	5.95	30.36	32.56
M6	41.77	36.56	31.24	28.83	26.56		37.73	40.25	39.32	14.61	21.73	21.51	9.4	6.18
M7	6.49	9.88	6.69	13.15	11.49	37.73		3.39	8.36	24.7	20.36	17.38	41.88	43.57
M8	3.32	8.75	9.73	14.02	14.48	40.25	3.39		6.28	26.73	21.68	20.39	44.77	45.97
M9	4.22	3.37	12.13	10.86	16	39.32	8.36	6.28		25	18.8	21.73	45.02	44.63
M10	27.77	22.07	18.82	14.29	14.92	14.61	24.7	26.73	25		7.26	12.4	21.95	19.65
A	22.07	15.65	15.78	7.97	13.48	21.73	20.36	21.68	18.8	7.26		14.09	29.21	26.42
B	22.7	20.2	10.69	14.6	5.95	21.51	17.38	20.39	21.73	12.4	14.07		24.56	27.65
C	46.82	42.65	35.17	35.28	30.36	9.4	41.88	44.77	45.02	21.95	29.19	24.56		11.33
D	47.3	41.75	37.15	33.94	32.56	6.18	43.57	45.97	44.63	19.65	26.46	27.65	11.33	