

The construction of a simple sand dumping barge to aid reburial of a shipwreck site

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Abstract

A gradual and unremitting decrease in the level of the sand forming the seabed in which the wreck of the *James Matthews* (1841) lies buried (located in Cockburn Sound, Western Australia) became a cause for concern as progressive deterioration of the structures on the site was taking place. The situation led to the innovative use of linked medium density polyethylene Traffic Management Delineator barriers (Omni OB1800) to create a walled enclosure around the site into which sand could be reintroduced to bury exposed structures and prevent its subsequent dispersal, as would be the case if it were simply dumped over the wreck. The shallow, 2.5m depth of water over the wreck site restricted the possibility of delivering a substantial quantity of sand via a large vessel or barge. Commercial dredging and pumping of sand was also considered but financial constraints ultimately ruled out any of these options. The volume of sand required to fill the enclosed area was calculated to be 165 cubic metres. To improve the rate at which a reasonable amount of sand could be added to the enclosure a small budget (\$2000 AUD) was provided by the Australian Historic Shipwreck Protection Project (AHSP) for the Western Australian Museum's team of retired, volunteer Marine Engineers to design and construct a 3m x 4m sand dumping barge. Costs incurred were mainly for the steel framework and floor components of the barge as they required materials of specific dimensions. A small boat winch and pulley were also specific purchases. Floation was provided by fourteen steel drums (each 200 litre capacity), which were obtained gratis. Note no labour costs were incurred to construct the barge.

Keywords: James Matthews, Barge, Sand dumping, Steel, drums, reburial.

Introduction

The wreck of the *James Matthews* (1841) is located in shallow water close to Woodman Point in Cockburn Sound and not far from the Port of Fremantle in Western Australia (Henderson, 2009). At the time of discovery, in the early 1970's,

the site was completely buried in sand except for one or two small concretions noticeable in the seagrass and a few pieces of scattered roofing slate that proved to be a part of the vessel's cargo. Excavation of the wreck site, not long after it was found, was extensive and reburial with the dredged overburden undertaken but the level of sand coverage was not completely satisfactory. The loss of extensive areas of seagrass over the years, that in part, afforded some stability to the sands that buried the *James Matthews*, have prevented the natural build-up of sediment at the site. In recent years it has become apparent that structures on the wreck site are deteriorating as they have become progressively more exposed. The nearby activities (approximately 300m away) of a dredging arm operating off the end of a reclaimer jetty, that is used to recover shell dredged further out to sea that is regularly dumped by barges, has created an extensive depression (12 m deep) in the seabed. This 'hole' and the associated barge channel leading to it have possibly contributed to a general decrease in the level of the nearby seabed, with its consequent impact on the wreck site, as sand in the vicinity gravitates towards these depressions.

To rebury most of the exposed structure at the *James Matthews* site it was determined that a depth of at least 0.8 metres of sand was necessary. Sand-trapping mesh covers have been previously trialled with success on parts of the site but an assessment of the overall area to be covered and the elevation of the structures within it implied that mesh alone was unlikely to be appropriate for total reburial. The situation led to the innovative use of 36 linked Traffic Management Delineator barriers (Omni OB1800), made of medium density polyethylene, to create a walled enclosure around the site into which sand could be reintroduced to bury exposed structures and prevent its subsequent dispersal, as would be the case if it were simply dumped over the wreck. For more information about the *James Matthews* and the Australian Historic Shipwreck Protection Project readers are referred to the papers in these conference proceedings by Richards et al., (2014) and Shefi et al., (2014).

Methodology

The shallow 2.5 m depth of water over the *James Matthews* wreck site restricted the possibility of delivering a substantial quantity of sand via a large vessel or barge.

Commercial dredging and pumping of sand was also considered but financial constraints ultimately ruled out any of these options. The volume of sand required to fill the enclosed area to the recommended height of 0.8m was calculated to be 165 cubic metres. To improve the rate at which a reasonable amount of sand could be added to the enclosure a small budget (\$2000 AUD) was provided by the Australian Historic Shipwreck Protection Project (AHSP) for the Western Australian Museum's team of retired, volunteer Marine Engineers to design and construct a 3 x 4m sand dumping barge (overall dimensions actually 3050 mm x 3900 mm). Costs incurred were mainly for the steel framework and floor components of the barge as they required materials of specific dimensions. A small boat winch and pulley were also specific purchases. Fourteen steel drums (each 200 litre capacity) were used in the construction, all of which were obtained gratis. Four drums were positioned vertically essentially halving the depth to which they would submerge and therefore halving their effective floatation capacity resulting in an overall buoyancy equivalent to twelve drums. Note no labour costs were incurred in the construction of the barge (Fig. 1).



Fig 1. The completed sand barge when first launched

Construction and Operation

The sand barge proposal for the *James Matthews* reburial project started out with a basic sketch comprising a series of 200 litre drums, arranged in a rectangular formation, including a floor that incorporated two doors, a locking mechanism and a raised-frame structure from which to operate a pulley system for closing the doors after sand was discharged. It was initially envisaged that the ends of the drums would be simply welded together, as a cost saving measure, although this didn't immediately address the issue of joining the drums at the barge corners. The

museum's team of volunteer Marine Engineers had the necessary skills and tools to construct the barge and would provide a free design process and labour. Construction was to be carried out using welded and bolted mild steel. Due to time constraints during its manufacture the non-galvanized metal parts of the barge were only painted with a corrosion inhibiting zinc undercoat. The engineers advised against direct end to end welding of the drums in favour of constructing a framework into which individual drums could be placed and replaced if no longer airtight. The dual doors were omitted in favour of a single central door. This was done to simplify its construction and operation but importantly to avoid the possibility of one door not operating in unison with the other and potentially resulting in the barge tipping over from the weight of the sand remaining on one side. The project began with the welded assembly of four individual outer frames made from angle iron (100 mm x 100 mm) designed to hold two horizontal drums on each of the fore and aft frames (1940 mm x 540 mm) and three horizontal drums on each side frame (3850 mm x 540 mm). Flat steel retaining straps (50 mm x 3 mm) were rolled to conform to the curvature of the drums and welded in place to fit across each frame. A detachable set of the curved straps, each with a screw threaded rod welded on the ends, were made to mate with corresponding holes to bolt the drums to the frame (Fig. 2).



Fig 2. The four outer-frames with strapped drums installed

As the horizontal drums at the corners of the barge could not be joined easily it was decided to mount an extra drum vertically at each corner. This also presented a curved surface and therefore cleaner 'entry' to the sea when the barge would be under tow and added the equivalent of an extra two drums to the overall buoyancy. The vertical drums were mounted on extensions to the side frames, the base of the

drum resting on a flat bar welded to form a triangle at each of the four corners. Each corner drum was secured by threaded rods (15 mm diameter) bolted through the extended frame and through a steel cross-strap positioned on top of each drum. All other nuts/bolts used to assemble the barge were 10mm in diameter. At this stage the four main drum frames (sides and ends, with drums temporarily removed) were bolted to a welded rectangular-shaped central frame (1800 mm x 2760 mm), made from angle-iron (100 mm x 100 mm) that was to become the frame work for the barge floor incorporating the door. The floor/door frame and frame of the actual door (800 mm x 2750 mm) were made from welded square section steel tube (75 mm x 75 mm). The open ends of the tube were fitted with cover plates and welded to be air-tight. To provide a strong floor and improve overall rigidity of the construction, steel 'C' section purlins (galvanized) were used (200 mm x 75 mm x 2 mm). The purlins were cut into short lengths and the ends welded to each side of the frames and to each other. This further improved floor strength and the overall rigidity of the barge (Fig. 3).



Fig 3. The main frames and door in position in preparation

To prevent sand dropping through any small gaps between various spot welded areas of the floor and door they were filled with silicon gap filler. The larger gap in the floor along the hinged side of the door was covered with a strip of sheet rubber adhered with contact cement onto the fixed portion of the floor frame. The hinge for the door was made from a single length of steel rod (23 mm diameter) mounted through drilled steel brackets welded alternately to the floor and door frames. This hinged shaft was prevented from sliding out of the brackets by securing it with locking pins incorporating washers to minimise rubbing and wear.

The catches holding the door in the closed position operate by rotation of a second full length steel rod, mounted in similar drilled brackets, possessing three welded lugs that come to bear and hold against a flat overlapping steel lip welded along the closing side of the door. This lip laps over the adjacent floor frame and prevents the door from being raised above its fully-closed position. The lip also helps to prevent sand loaded into the barge from dropping through the clearance gap for the door. The door locking shaft is prevented from slipping out of its mounting brackets by the door locking lugs as each of the three lugs is rotated between two brackets welded to the floor frame. One end of the locking shaft has a right-angle lever welded to it that almost horizontally aligns with a welded 'U'-shaped bracket when the door is in the closed position. The 'U' bracket retains a steel ring of sufficient internal diameter for it to slide along the bracket and simultaneously over the door locking lever. This is achieved by applying downward hand-pressure on the lever to bring it into a parallel position with the bracket. Once released the lever locks the ring in place as it attempts to spring back to its former position. To open the door the ring is struck with a long-handled hammer until it drops off the lever (and is retained by the bracket) and the weight of sand on the barge floor forces the door to open. As the door drops down the actuating lever rapidly goes up in the opposite direction (Note this is a safety concern and the person releasing the lever must keep well clear of the lever and descending door).

To raise the door and temporarily hold it closed, a small ratchet-type boat winch with a stainless steel cable, attached by a shackle to the door, is mounted on a bracket attached to a tripod frame with a pulley wheel fitted to its apex. The ratchet system allows the winch to hold the door in the closed position in order for the lever locking ring to be re-engaged. The winch was inexpensive and its pulling capacity (500 kg) and gear ratio (3:1) more than sufficient to raise the door but it was not intended that it be used to hold the weight of a load of sand. Before the door is opened with a load of sand the winch ratchet must be disengaged to allow the winch to free-wheel and the cable to run out (Note this was a safety concern as the winch handle could not be detached and its rapid rotation seen as a potential risk to the operator who must keep well clear until the door is released and it has to be raised again).

During the construction process the sheer weight of the main components of the sand barge (~700 kg), particularly the central frame with its floor and door, presented handling issues both during its manufacture and its physical loading and unloading

from the truck at the deployment area. Although it is possible to lift and carry the main parts of the barge separately albeit with 6 to 8 personnel and then assemble it before it is launched, it is recommended that a truck with a HIAB crane be hired to load the fully assembled barge onto the truck and then unload the barge directly into the water. This method of deployment was used when the sand barge was again utilised in the concluding phase of the fieldwork. **Field Operation**

As stated, during the main fieldwork phase, the sand barge was physically handled as separate components as it was too wide to fit on the tray of the museum's truck when fully assembled. The disassembled sand barge was delivered to a boat ramp where the barge was unloaded, the floor section placed on a four wheeled support frame, the remaining components bolted to it, the drums installed and the barge launched down the ramp restrained by a rope. The fourteen drums provided appropriate buoyancy despite some initial concern that the weight of the overall framework and particularly the floor with its door was excessive. To minimise the possibility for metal fatigue and/or loosening of the retaining bolts, caused by any rocking motion of the corner drums when the barge was underway, a rope was secured between the drums to prevent any unwanted movement. A tow rope was attached to two shackles fixed near the corners of the bow and the barge towed to the sand loading area.

Initially clean, washed proprietary sand was physically loaded into the barge by emptying sand bags (maximum weight 20 kg) carried directly from a nearby beach and then subsequently from a larger boat moored adjacent to the wreck site. The loaded barge was not difficult to manoeuvre over the wreck site using a combination of small boats and ropes then, aided by snorkelers, it was easily moved into its final position for discharging the load of sand (1.0 - 1.5 ton) (Fig. 4).



Fig 4. Manoeuvring the loaded sand barge into position

The hammering of the ring to release the door and its re-locking was performed by a snorkeler using the procedure described in the *Construction and Operation* section of this paper (Fig. 5).

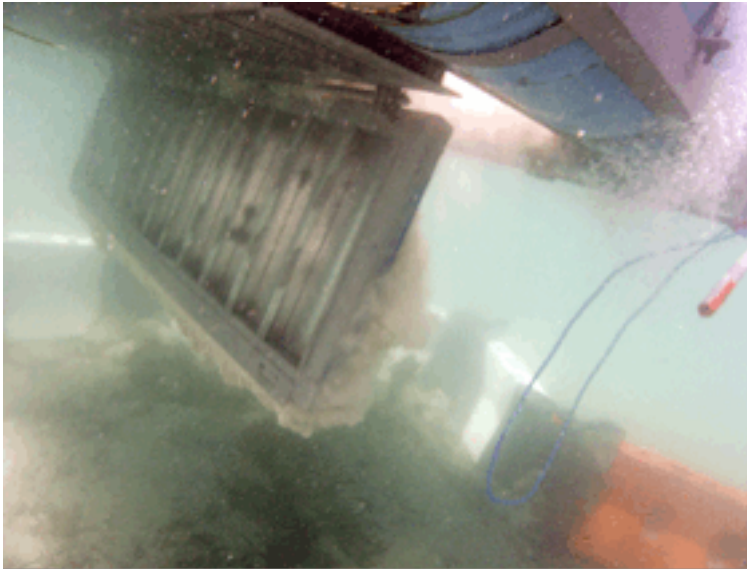


Fig 5. The door opening to release a load of sand onto the

A second snorkeler disengaged the ratchet on the winch before the door was released and re-engaged the ratchet to close the door after all the sand was removed from the barge. As the single door is centrally located and it does not cover the entire floor a ledge of fixed floor (480 mm wide) on either side retained sand that snorkelers easily removed by hand (Fig. 6).



Fig 6. Snorkelers removing sand not directly released when the door opened

At the end of the day the barge was left moored over the *James Matthews* site, two solar cell charged lamps were attached as riding lights to warn fishers in small boats should they be travelling in the vicinity of the wreck at night.

Conclusion

In operation the sand barge performed very well. In the restrictive circumstances of budget constraints and the shallow water situation of the *James Matthews* wreck site the barge provided a means of delivering a reasonable quantity of sand with each load (1.0-1.5 ton). The overall amount of sand delivered to the site at this stage of the project is 20 m³ or 30 ton, which is the equivalent of about 5-10 cm of sand

coverage over the entire site. Obviously significantly more sand is required, however due to the sand barge's robust construction an idea that was perhaps, initially, conceived as a basic and relatively cheap construction, to be used only once and then disposed of, is currently held in storage for future use.

Acknowledgements

The Marine Engineers team comprises of eight retired marine engineers and their manager, Richard Garcia. The two persons, Jim Grehan and Jan Dols, engaged full-time in the barge manufacture, are listed as main contributors to this paper. The additional contribution of the other team members, however small, is still considered significant and is hereby gratefully acknowledged.

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Figure captions

Fig. 1 The completed sand barge when first launched. (J. Carpenter)

Fig. 2 The four outer frames with strapped drums installed. (J. Carpenter)

Fig. 3 The main frames and door in position in preparation to install the floor sections either side (assembly is inverted). (J. Carpenter)

Fig. 4 Manoeuvring the loaded sand barge into position. (J. Carpenter)

Fig. 5 The door opening to release a load of sand onto the *James Matthews* site inside the wall of barriers. (J. Carpenter)

Fig. 6 Snorkelers removing sand not directly released when the door opened. (J. Carpenter)

Biography

Jon Carpenter is a conservator with 40 years of experience working principally with maritime archaeological materials at the Department of Materials Conservation, Western Australian Museum. The work performed is mainly with iron objects recovered from marine sites and he has conserved cannon from the earliest known shipwreck in Australia, the Trial (1622) and from HMS Sirius (1790), the Principle Escort of the First Fleet transporting colonists to Australia in 1788. As a diver and conservator operating in the field he conducts pre-disturbance assessments of shipwreck sites, including digital photography/video and on-site conservation of recovered artefact material.

Jim Grehan is a former Technical Officer with the History Department of the Western Australian Museum. Prior to retirement he worked extensively in the off-shore industry as a welder/fitter with engineering skills.

Jan Dols has 10 years experience as a welder/fitter and prior to retirement worked as a qualified Marine Engineer for 35 years.