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## Historical period stone anchors from Vijaydurg on the west coast of India

Sila Tripathi, A.S. Gaur, Sundaresh and S.N. Bandodker

Marine Archaeology Centre, National Institute of Oceanography, Dona Paula, Goa, 403 004, India

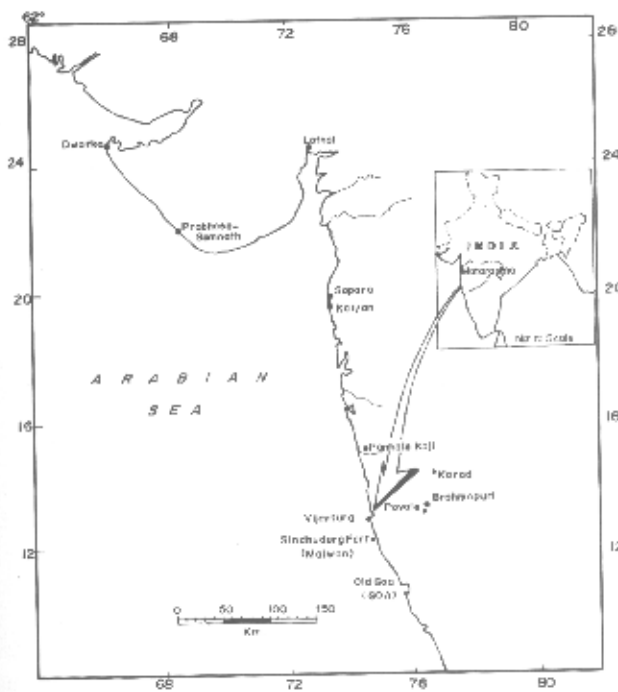


Figure 1. Map showing the location of sites mentioned in the text. (Drawing: S. Chitari)

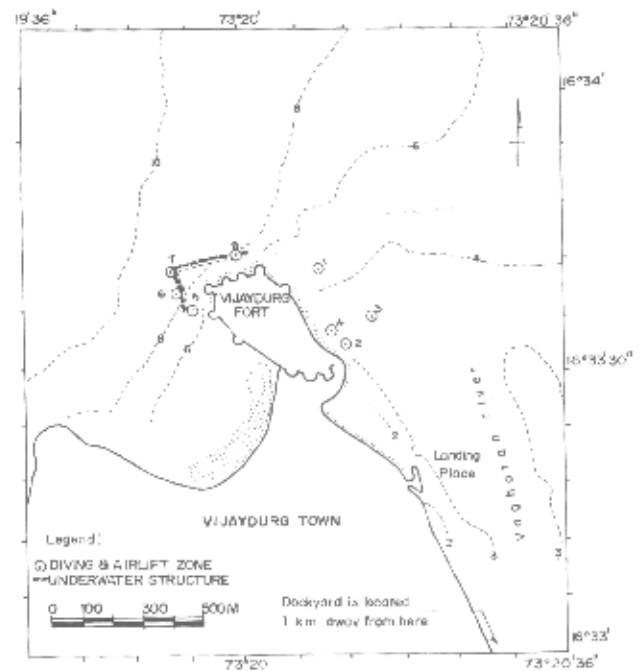


Figure 2. Figure showing diving locations, airlift operation and underwater structure in Vijaydurg waters. (Drawing: S. Chitari)

### Introduction

Vijaydurg was a minor port situated on the bank of River Vaghotan in Sindhudurg district of Maharashtra. It was also identified with the Byzantine by Ptolemy and Periplus in the 1st and 2nd centuries AD (Schoff, 1974). It had direct trade contacts with Sopara and Kalyan. During ancient times the inhabitants of this region came by sea from other places. Studies of nearby archaeological sites such as Brahmपुरi have shown the existence of Satavahana coins and evidence for contacts with the Mediterranean world during 200 BC to AD 200. The other Buddhist sites of nearby region are Panhale Kaji, Karad and Povale (Fig. 1). Vijaydurg port lost its glory after the end of the Satavahana regime in the region during 234 BC to AD 207, until the time when this area was absorbed into the Empire of Shivaji (AD1630-1680), the Maratha king and afterwards. Shivaji made Vijaydurg the main naval base. It was so strongly fortified that the Europeans used to call the Vijaydurg Fort the 'Gibraltar' of India. The contemporary literature shows that there were frequent naval battles between the Marathas and the Europeans during the 17th and 18th century which led to the loss of number of a ships in Vijaydurg waters.

Work was initiated by us, in 1995, to explore and excavate shipwrecks in Vijaydurg waters. Based on this

exploration, this paper focuses on the stone anchors found in the Vijaydurg Fort wall and dockyard area, their probable date and comparison to anchors found elsewhere in India.

### Onshore and offshore exploration of Vijaydurg

Marine archaeological explorations were carried out in Vijaydurg waters to locate remains of port installations and other underwater and coastal maritime structures. The sea-bed survey was carried out to assess the nature of the sea-bed in and around the working site without disturbing the objects. These operations were based on the use of known historical data in an unexplored area such as Vijaydurg. Diving and airlift operations (Fig. 2) were undertaken in the Vaghotan creek and on the western side of the Vijaydurg Fort at 8 to 10 m water depth. An Osprey model Underwater TV camera was deployed for visual documentation and a Nikon V camera with 35 mm wide angle lens was used for still photography. The Pulse 8 X hand-held metal detector was also used for locating metallic objects. Magellan NAV 5000 DLX GPS was used for accurate position fixing. Underwater exploration revealed a linear stone structure made of irregular weathered stone boulders on the western side of the Vijaydurg Fort about 100 m seaward. It is presumed

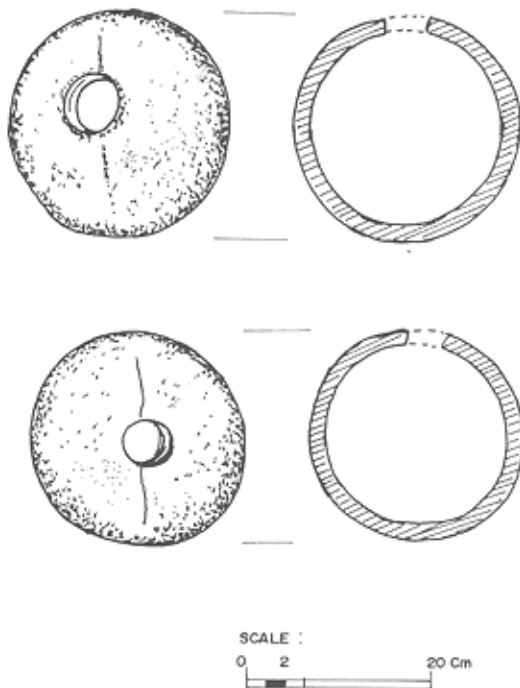


Figure 3. Cast iron sling shots recovered during underwater operation at Vijaydurg. (Drawing: S. Chitari)

that the structure was constructed during the Maratha Period for the purpose of damaging enemy ships as well as to protect the fort from wave and current action. The airlift excavation revealed coal, shale and pottery of medieval period at 3 m below the sediment-water interface. The other findings are two cast iron sling shots (Fig. 3), a few sherds of Chinese ceramic and timber of wrecked ships. Substantial changes of the outer core of the sling shots may be due to extensive weathering (Fig. 4) (Sila, *et al.*, 1998).

Onshore explorations revealed a dockyard locally called Godi (Fig. 5) about 3 km from Vijaydurg on the bank of the River Vaghotan. This dockyard was built by Kanhoji Angre, the Maratha Admiral during the 17th century AD. Later, Anand Rao Dhulap increased the capacity of the dock to hold ships of 500 tons (Fig. 6). A number of grapnel stone anchors and a triangular stone anchor were noticed in the adjoining areas of the dockyard during onshore exploration (Fig. 7), and on the parapet wall (Fig. 8) of the Vijaydurg Fort (Sila, 1996).

#### Description of stone anchors of the dockyard

The stone anchors were erected on both sides of the entrance of the dock and were used as mooring stones. They are made of locally available porous laterite, beach rock, sandstone, dolerite and dyke. The surfaces of these anchors have undergone weathering due to exposure.

Eight anchors were found on the right side wall of the dock. Of these, three were found erected on the wall; two



Figure 4. Cast iron sling shots, found in Vijaydurg waters. (Photo: S.N. Bandodkar). Scale in 2 cm units.

have been embedded in the soil where only the top portions are visible now; and the other three are lying on the eastern side of the wall. Two of the anchors are broken but the rest are in good condition. Prototypes of two more anchors were found erected on the left side wall and are in good condition. In addition, five more grapnel stone anchors were noticed behind the dockyard. Three of these were at one place, while the other two were erected at different places and used as mooring stones.

Anchor No. 1, a grapnel-type stone anchor of beach rock, is erected behind the dockyard. Some lower portion of the anchor is buried in the ground. All three holes are visible.

Anchor No. 2, a yellow conglomerate, calcareous sandstone, grapnel type stone anchor is erected vertically on the ground. The anchor has been tapered upward. Only the lower two holes are visible. The narrow upper portion has deteriorated by weathering.

The other grapnel-type, yellow sandstone anchor No. 3 is also observed opposite to anchor No. 1. The top hole and lower holes are visible. These three anchors are laid

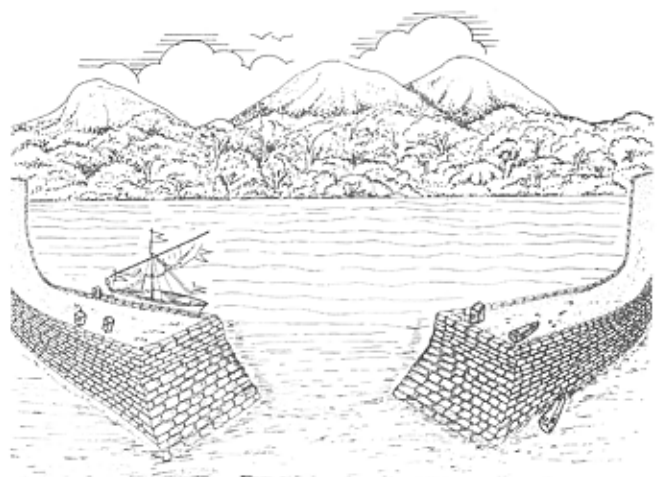


Figure 5. Artistic view of the dockyard of Vijaydurg. (Drawing: V. Gowthaman)



Figure 6. General view of the dockyard of Vijaydurg. (Photo: S.N. Bandodkar)

in the form of a gate and are probably to prevent soil erosion (Fig. 9).

Anchor No. 4 is also a grapnel type, sandstone anchor. It is buried upside down in the ground. The top hole is beneath the soil and the two lower, square holes are visible. Similarly, anchor No. 5 is made of sandstone, is a grapnel type and all holes are visible; it is laid on the right enclosure wall of the dockyard (Fig. 10).

Anchor No. 6 is a grapnel type stone anchor found near the right enclosure of the dockyard. Lower holes are visible but the top hole is not seen.

Anchor No. 7, lying near the dockyard, is made of yellow conglomerate sandstone; it is submerged during high tide (Fig. 11). The surface of the anchor is uneven.

Anchor No. 8 is buried in the ground and is broken on top. The lower holes are within the soil but the top hole is visible. The top portion of anchor No. 9 is also broken. This anchor is buried on the right enclosure of the dockyard. Only one hole is visible.

Anchor No. 10 is made of yellow sandstone; its top hole is buried in the ground and only one lower hole is visible; the other hole is broken. Anchor No. 11 lies horizontally on the ground; its top and one lower hole are broken, and the other lower hole is visible.

Anchor No. 12 is a calcareous sandstone anchor, buried with no holes visible.

Anchor No. 13 is buried upright on the left enclosure wall of the dockyard; its top portion is broken but only the top hole is visible. Probably the other holes are beneath the ground (Fig. 12).

Anchor No. 14 is buried and the top hole is in the ground; the lower two holes are visible.

Anchor No. 15 lies on the left enclosure wall of the dockyard. Only one lower hole is visible. There is a cut at the top of the anchor. Top and other lower holes cannot be seen so measurements have not been taken. All the measurements of the grapnel stone anchors of the

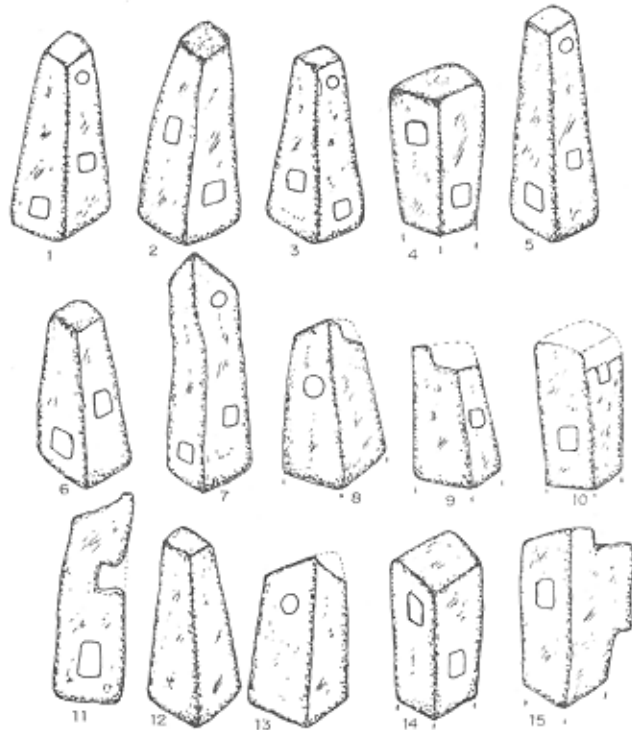


Figure 7. Stone anchors of grapnel type found in the adjoining area of the dockyard. (Drawing: S. Chitari)

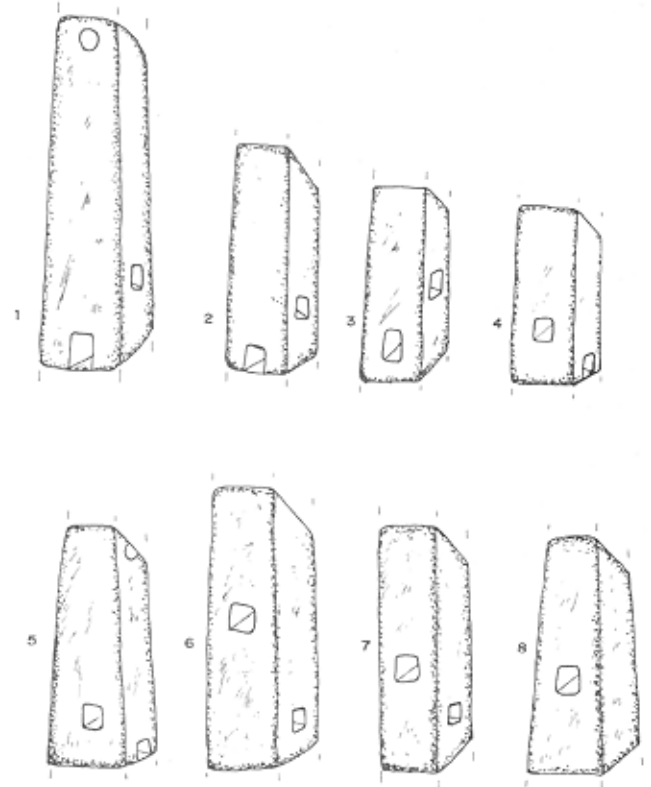


Figure 8. Grapnel type stone anchors used as a lintel in Vijaydurg Fort. (Drawing: S. Chitari)



Figure 9. Stone anchors of grapnel type are laid on the ground to prevent soil erosion behind the dockyard of Vijaydurg. (Photo: S.N. Bandodkar) Scale in 10 cm units.

dockyard region are given in Table 1 with reference to Figure 13.

Anchor No. 16 is the only triangular sandstone anchor (Fig. 14). All the three holes as well as chisel marks are visible on the anchor. The state of the anchor is good. Details of this anchor are given in Figure 15.

Table 1. Dimensions of the grapnel anchors found in the adjoining area of the dockyard.

No	A	B1	B2	C	D1	D2	E	F	G	H	I
1	180	35	37	120	15x15	17x15	15	-	60	40	36x36
2	185	25	37	160	20x15	15x12	-	25	50	-	37x38
3	175	34	40	125	15x15	15x15	12	50	-	25	37x37
4	70	38	39	47	15x15	17x17	-	22	-	-	38x39
5	200	34	40	160	17x16	17x15	13	40	60	38	45x35
6	150	48	39	82	15x15	16x14	-	24	68	-	40x35
7	218	37	43	135	18x17	19x17	17	52	28	40	38x40
8	100	32	35	44	-	-	15	-	-	44	36x28
9	65	35	30	45	15x15	-	-	10	-	-	30x-
10	68	-	35	43	16x15	15x15	-	10	35	-	42x35
11	105	35	40	62	17x16	-	-	25	-	-	35x-
12	90	25	30	-	-	-	-	-	-	-	-
13	77	30	35	-	-	-	13	-	-	30	35x30
14	77	37	40	43	12x12	18x12	-	15	43	-	40x35
15	80	-	-	-	12x15	-	-	45	-	-	40x32



Figure 10. Stone anchor of grapnel type lying on the right enclosure wall of the dockyard of Vijaydurg. (Photo: S.N. Bandodkar) Scale in 10 cm units.

#### anchors of Vijaydurg Fort

In the second fortification wall of the Vijaydurg Fort eight grapnel type stone anchors were noticed which were used as lintels (Fig. 16). The state of preservation of these anchors is good. All these anchors are made of locally

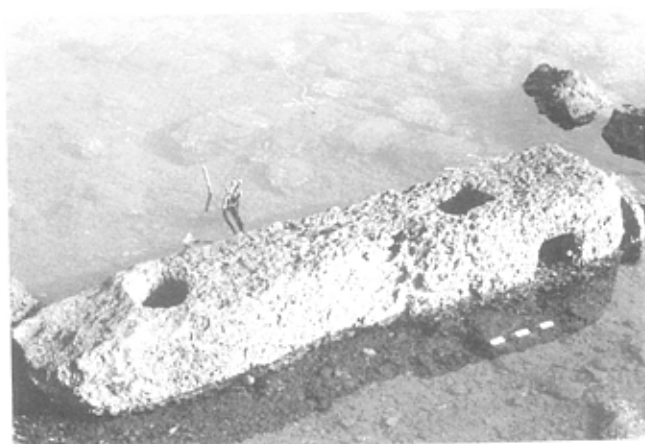


Figure 11. Stone anchor of grapnel type lying near the dockyard of Vijaydurg. (Photo: S.N. Bandodkar) Scale in 5 cm units.



Figure 12. Stone anchor of grapnel type used as mooring bit found on the left side wall of the dockyard of Vijaydurg. (Photo: S.N. Bhandodkar)

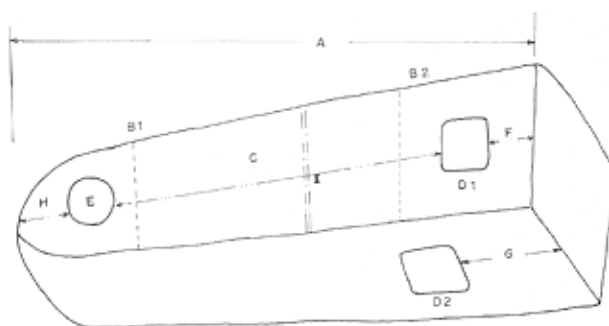


Figure 13. Grapnel stone anchor with all measurements.

anchors are taken from the visible parts and shown in Table 2. It appears that all anchors have three holes; however, in six anchors only two holes are visible and the top hole is completely hidden inside the wall. The top hole is visible on only two anchors. Chisel marks are also observable on these anchors.

**Petrology of the region**

A general stratigraphic sequence in and around the investigated area includes rock types from Pre-Cambrian to Mesozoic and Quaternary age (Gujar, 1996). The generally observed sequence of these formations and their lithology is as below:

1. Quaternary beach sands, soils, alluvium, laterite etc.
2. Tertiary white and blue clays with thin carbonaceous layers.
3. Mesozoic Deccan trap basalt, Dyke and Kaladgi sandstone.
4. Protozoic Dolorite, Schist, Gneises, Quartzite, Conglomerate.

**Discussion**

In India, no record exists on usage of stone anchors, however, reference to anchors are found in ancient Sanskrit texts, in which the term ‘Nangara’ (meaning anchor) has been used in a few places. Sailors and seamen of ancient India used different primitive types of stone

available sandstone. Both ends of these anchors are embedded in the wall (Fig. 17), and only the centre portions are visible. Similarly, at the entrance of Padamgad Fort at Malwan a grapnel anchor had been used as a lintel (Sila & Gaur, 1997). The grapnel anchors were suitable for being reused as lintels and mooring bits because they were able to bear heavy loads. These anchors had similar shapes but were of different sizes. Measurements of the

Table 2. Dimensions of the grapnel anchors used as a lintel in the Vijaydurg Fort.

No.	Type of anchor	Raw material	Length (cm)	Width at lower and top side (cm)	Distance between lower hole and top (cm)	Maximum width at centre (cm)	Lower hole (cm)	Lower side hole (cm)	Top hole (cm)
1.	Grapnel	sandstone	138	36 x 33	123	35	15 x 15	14 x 14	11
2.	Grapnel	sandstone	110	40 x 35	94	37	14 x 14	17 x 17	not visible
3.	Grapnel	sandstone	108	40 x 35	101	40	15 x 15	15 x 15	not visible
4.	Grapnel	sandstone	106	40 x 35	73	39	14 x 14	15 x 15	not visible
5.	Grapnel	sandstone	113	32 x 27	79	30	14 x 14	14 x 14	11
6.	Grapnel	sandstone	117	38 x 28	39	34	14 x 14	15 x 15	not visible
7.	Grapnel	sandstone	115	33 x 33	56	35	16 x 16	14 x 14	not visible
8.	Grapnel	sandstone	62	36 x 36	36	36	14 x 14	not visible	not visible



Figure 14. Triangular stone anchor found 200 m beyond the dockyard of Vijaydurg. (Photo: S.N. Bhandodkar) Scale in 5 cm units.

anchors made from unworked stones. Gradually, these stone anchors took triangular and grapnel shapes and were replaced by iron anchors in the later period.

The drilling of rectangular, square or round holes on the anchor depends on the method of use, and skill of the craftsmen and users. The shape and location of holes on the anchors have been different from place to place and region to region but, in India, the position of the holes on anchors have been observed to be the same at all locations examined so far. Holes are bored right through the alternating faces of the anchor. The rectangular or square holes were meant for wooden flukes that functioned like the flukes of a metal anchor to hold the anchor to the seabed; the round holes are believed to have been intended for the cable or rope. It seems that rectangular holes were suitable for proper gripping of the wooden flukes. In India, to date, no wooden fluke remains are reported in anchor holes. It is not certain, therefore, whether curved or straight flukes were used by the Indian sailors. According to the size of the anchors it is presumed that no more than two persons were required to lift these anchors. In the case of the grapnel anchors of Vijaydurg, two rectangular

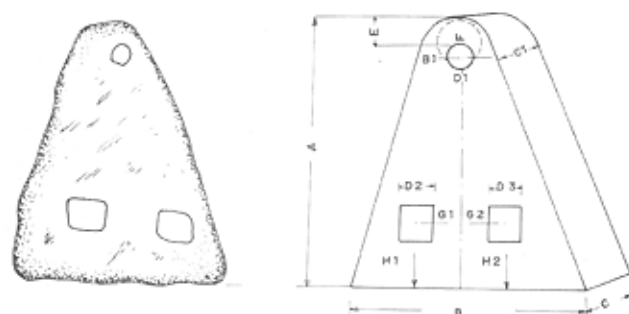


Figure 15. Anchor dimensions (after Galili *et al.*, 1994: fig. 17, with additions to accommodate all three anchor holes).

- A—Maximum height: 1.90 m
- B—Maximum width at lower part: 0.85 m
- B1—Maximum width at hole centre: 0.47 m
- C—Maximum thickness at lower part: 0.20 m
- C1—Maximum thickness at hole centre: 0.20 m
- D1, D2, D3—Average hole diameters: 0.13, 0.19, 0.15 m
- E—Distance from hole to top of anchor: 0.36 m
- F—Distance between apex centre and hole centre: 1.60 m
- G1, G2—Distance from centre of lower hole to anchor's vertical axis: 0.10 m (each side)
- H1, H2—Distance from centre of lower hole to anchor's base: 0.17 m

holes noticed in the lower side, which are at right angles to each other, are meant for pointed flukes and the round hole, at the narrower upper end, for the rope. It seems that these anchors are suitable for a coralline bottom and essential for shores of the Indian ocean (Raban, 1990). In India, no grapnel anchors were found with grooves at the base as are commonly found in the Red Sea (Kapitan, 1994). It is understood that more effective than the weight of the stone anchor are the wooden flukes which provide additional grip for the anchor to hold on to the sea floor. It is also not clear during which period iron was first used for making anchors. Lead stocks have not been encountered in Indian waters. In India no evidence of stone-stocked or lead-stocked, wooden anchors has ever come to light.

Unless associated material is found, stray findings of anchors can only provide some clues—on the basis of shape, size, type and classification—to assess the approximate age. The anchors have been cut from locally available sandstone, laterite, beach rock, dolerite and dyke blocks, and so the surfaces are not smooth. At some places chisel marks are also visible. Some have been damaged and broken since the time when they were in use. All these anchor forms bear resemblance to each other and to the traditional anchor type of Dwarka as well (Rao, 1990). Stone anchors have been in use in India for several centuries. The number of triangular and grapnel type stone anchors are more or less similar in Dwarka and Prabhasa-Somnath (Rao, *et al.*, 1992), whereas grapnel stone anchors are more numerous at Vijaydurg. As the



Figure 16. Grapnel stone anchors noticed as lintels on the arches of the parapet wall of the second fortification of Vijaydurg Fort. (Photo: S.N. Bandodkar) Scale in 5 cm units.

later period iron anchors are available at the Archaeological Museum, Old Goa, and some other places, it is assumed that, until the Europeans arrived in India, stone anchors were in use. The Marathas had the technology to manufacture cannons, guns and other weapons and so it is reasonable to believe that the Marathas might have used iron anchors for anchorage and stone anchors for the purpose of mooring. However, there is strong circumstantial evidence that, during the 17th century, iron anchors were in widespread use, hence the stone anchors were reused as mooring bits as well as for various other purposes, such as the lintels of the fortification walls.

These anchors are uniformly chiselled. They have a broad base and taper slowly upward. The use of these compound stone anchors offered safety and was soon adopted by sailors and merchants all along the Indian coast. These stone anchors had good quality to hold position and were easy to lower and lift thus making them ideal for sea-going vessels. Further, the anchors were heavy enough, and thus were suitable, for mooring vessels of large tonnage.

Composite anchors were more effective than the weight anchors in varying sea-bed conditions. A rocky sea floor is not suitable for proper anchorage unless the anchor holds firmly to the rocks. The ancient mariners of India were well aware of suitable anchorages along their trade routes. The sailors used to carry a number of anchors on their vessels. There is a close relation between the anchor

and ship size. It is certain that the triangular stone anchors are of an earlier period than grapnel anchors. Secondly, grapnel anchors serve the dual purpose of anchoring and mooring. (As these anchors were suitable for moorings and lintels a number of grapnel anchors were found in the Vijaydurg region.) The grapnel anchors were bigger, heavier and stronger than the triangular anchors; so it would seem that these anchors belong to a later period. As the grapnel anchors are more numerous, it appears that, during historical and medieval periods, the grapnel anchors were more commonly used than the triangular anchors.

#### Probable date

Stone anchors are the primary antiquities in marine archaeological studies. The discovery of these stone anchors adds new information on the maritime history of Vijaydurg. Unfortunately, there are no ancient antiquities close to the dock to date the anchors. The evidence of stone anchors in India dates back to 2500 BC, from land excavations at Lothal (Rao, 1985) and Kuntasi (Dhavalikar, *et al.*, 1996). Similar types of triangular anchors have also been observed during the underwater explorations at Dwarka and Prabhasa-Somnath, and these anchors date from as early as 1400 BC. A depiction of a stone anchor has been noticed on a square Harappan seal (Konishi, 1985). Recently, stone anchors have also been found at Sindhudurg Fort of Malwan (Sila & Gaur, 1997).

The size, shape, age and raw materials for these anchors differ from place to place. These anchors are similar in their nature and treatment. The triangular stone anchor can be compared with the triangular stone anchors of the Mediterranean (Frost, 1970) and Egypt (Frost, 1979). The triangular anchor from Vijaydurg which is presented here is probably of the Early Historic Period. No archaeological evidence has been found in the Vijaydurg region prior to the early historic period, so this anchor may not antedate Early Historic Period. During Asokan Period (273–236 BC) the Buddhist monks and merchants entered this area. Panhale Kaji, Brahmapuri, Povale and Karad are the nearby Buddhist sites datable to the 3rd century AD (Deshpande, 1986). The spread of Buddhism in this region was only possible due to the trading communities of Brahmapuri area. Archaeological excavations at Brahmapuri yielded Satavahana coins, the Roman sea God and bronze vessels of Roman origin which are datable from 200 BC to AD 200 (Ghosh, 1989). The Satavahana coins have been found at Kolhapur and other locations closer to Malwan.

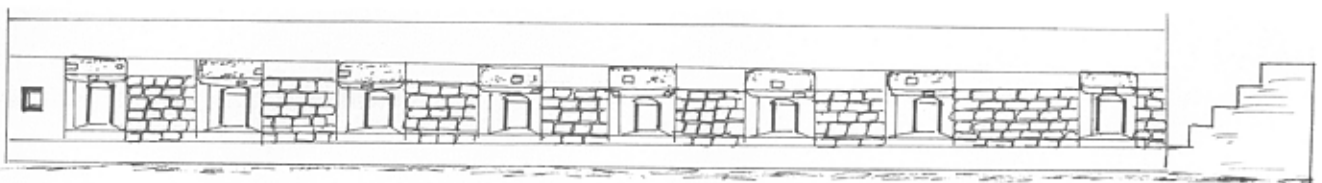


Figure 17. Reuse of grapnel stone anchor as a lintel in the second fortification of Vijaydurg Fort. (Drawing: S. Chitari)



Similar type of grapnel stone anchors were reported from the Red Sea at the Lone Mushroom wreck (Raban, 1990), and at Kilwa Kisiwani and Mogadishu on the East African coast (Chittick, 1980). Land excavations at Siraf revealed a prototype of stone anchors which is datable to the 8th century AD (Whitehouse, 1970). Recent explorations at Oman have brought to light the grapnel type stone anchors (Vosmer, T., 1997, pers. comm.). This type of stone anchor is associated with Arabic traders, non-Mediterranean and proto-grapnel (Frost, 1985). If these anchors were associated with Arab traders then these anchors belong to the 8th century and continued into a later period. The Arab traders were very active in the Indian Ocean during the 8th century (Hourani, 1975). The most important point is that the grapnel anchors are only reported from the Indian Ocean countries.

### Conclusion

For the first time along the Maharashtra coast, the reuse of stone anchors has been noticed at Malwan and Vijaydurg. The stone anchors and the dock provide the only evidence indicating that Vijaydurg was a port. The stone anchors have helped in reconstructing the maritime history of Vijaydurg. It is observed that, with the advent of iron anchors, the stone anchors were reused as mooring bits and lintels. The archaeological findings, Satavahana coins and the description of Periplus and Ptolemy, as well as Buddhist sites of the nearby region of Vijaydurg, suggest that the triangular anchor belongs to the Early Historic Period. The grapnel anchors which have been found at other places on the west Indian Ocean coast belong to the Historic Period and the grapnel anchors of Vijaydurg are similar to them, so it is also presumed that these anchors of Vijaydurg also belong to the Historic Period.

### Acknowledgement

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