Ancient anchorage system in India with reference to Gujarat coast

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Abstract

The Indian coast, with a long history of maritime activities, has been dotted with several ancient ports. The evidence for this exists in port-related structures on the shore and in relics lying in the sea adjacent. Marine archaeological explorations have revealed the existence of jetties at Porbandar and Sultanpur and offshore anchoring points at Miyani, Visawada and Somnath, Kodinar and Ghogha on the Gujarat coast. The preferred anchoring points fall in a water depth of 5–7 m. This paper also discusses the effect of tide when using jetties and loading points along various parts of the west coast India.

1.0 Introduction

The Indian coast, with a long history of maritime activities, has been dotted with several ancient ports. The evidence for this exists in port-related structures on the shore and in relics lying in the sea adjacent. Marine archaeological explorations during the last two and half decades have revealed the existence of ancient jetties at Dwarka, Rupen Bandar, Porbandar and Sultanpur and offshore anchoring points at Bet Dwarka, Miyani, Visawada and Somnath, Kodinar and Ghogha on the Gujarat coast. The other important remains are comprised of stone anchors of various types such as composite, Indo-Arab and ring stone type. They are of various sizes weighing between 20 and >1000 kgs. The sizes indicate the uses of various sizes and types of boats visited this coast or were manufactured along this coast during the different phases of history.

Mesopotamian texts vividly described the existence of docks in the 3rd millennium BC. The king Sargon the Great was quoted to boast that boats of Dilmun, Magan, and Meluhha lay anchored at the docks of Agade, which was his capital (Kramer, 1964, 44-52). Excavations at Ur on the bank of Euphrates had revealed a massive brick structure, identified as a harbour (Woolley, 1974, 63), which is the oldest remnant of any port structure in the world. Similarly, archaeological studies of the oldest known civilization of the Indian subcontinent, namely the Indus Civilization, indicate that Lothal (Rao, 1979, 70), and Kuntasi (Dhavalikar et al., 1996, 76) might have served as tidal ports (situuated on the river banks) on the Gujarat coast. Kautilya (Shamasatry, 1915, 168) in his Arthasastra has mentioned a Superintending of Shipping (Navadhyaksha) who was in charge of oceangoing ships and strictly enforced the rules framed for the management of ports. He was empowered to destroy pirates and punish
those who did not follow the rules. The owner of the ship had to pay taxes before leaving the port. The author of *Periplus of the Erythrean Sea* dating back to the 1st AD (Schoff, 1912, 38-47) has mentioned a chain of ports along the Indian coast. Several ancient texts, including Indian and foreign, have made ample references on the existence of harbors and ports along the Indian coast during the historical and the medieval periods. Several structures associated with ports and jetties have been discovered along the Mediterranean coast including at Carthage and Thapsus on the Tunisian coast (Muckelroy, 1977, 79-80), Caesarea on Israel coast (Raban, 1981, 287-308) etc.

Sanskrit term for the port is *Pattana* that has been used in various ancient texts. *Pattana* used to be two types namely *Samudrapattana* i.e. port on the coast of a sea and *Jalapattana* on the bank of a navigable river (Roy, 1994, 33-36). De Kerchove (1948, 598) in the dictionary of maritime archaeology described port as “a place for the loading and unloading of vessels recognized and supervised for maritime purposes by the public authorities”. Further he adds on the differences between port and harbor “a port may possess a harbor but a harbor is not necessarily a port. Any natural creek or inlet on the seashore with adequate depth of water and sufficient shelter for ships fulfills the essential conditions of a harbor. To make it a port, in the accepted sense of the word there must be in addition accommodation and facilities for landing passengers and goods and some amount of overseas trade.”

It is interesting to note the effect of prevailing tide in relation with jetties and anchoring points along various parts of the west coast India. The archaeological evidences indicate that two gulfs of Gujarat coast (Gulf Kachchh and Gulf of Kambhat) witnessed the hectic maritime activities in the past. Both gulfs have very high tidal range and the Gulf of Kambhat has the second highest tidal range in the world (11 m). Ancient texts such as *Vishnu Puran* and *Periplus of the Erythreanean Sea* vividly describe the tidal range and its uses for the navigation purposes. The discovery of the large number of stone anchors in inter tidal zone along the gulf region support the above references.

The anchors are integral part of the navigation. Ships or boats must use an anchor where jetties are not there to keep her steady at one place, say at open sea where creek merges with sea at suitable water depth. Generally, the anchoring points have a rocky seabed as an anchor need to hold the boat firmly. The underwater investigations on the Saurashtra coast have clearly helped to mark several ancient anchoring points from where stone anchors were found, in water depth of 5 to 7 m. These observations correspond well with the depth of the traditional anchorage points all along the Indian coast. The underwater observation revealed that seabed topography between Bet Dwarka on the extreme west and Somnath on the east is almost less variants particularly at Dwarka, Miyani, Visawada, Porbandar, Tukda and Somnath. The seabed topography is comprised of the rocky formations with numerous channels filled with fine sand. The stone anchors were trapped in these channels and between the rocks, which were suitable for holding big boats like Arab Dhows and the Indian Vahan. The observation at Bet Dwarka and Porbandar revealed that boats of carrying more than 100 tons of cargo are anchored in a water depth of 4 to 5 m and some time they are resting on the sandy beaches during low tide. Exception at Somnath has been observed that most of the anchors are reported from 8 to 12 m water depth that
indicates the anchoring point at Somnath was in comparatively at deeper depth. This phenomenon could well be connected with low tidal height at Somnath, where boat needs to continuously float. However, the majority of these anchors belong to ring stone type.

The paper discusses the underwater explorations undertaken along the southern Saurashtra coast. The focus is on the remains of ports and anchorage points. The use of natural phenomena like tidal range has been discussed in detail.

2.0 Marine Archaeological Investigations along the Saurashtra coast

Except Okhamandal region the major marine archaeological explorations on the Saurashtra coast has been carried out in the first decade of 21st century. The important site include Miyani, Visawada, Kindar Kheda, Porbandar, Mithivirdi, Kodinar, and in the Gulf of Kambhat (Figure 1). A large number of stone anchors found from these sites (Table 1). The brief description of each site is given below.

2.1 Miyani

Miyani is situated about 40 km east of Dwarka. This is also famous for ancient temples dating back to the 10th century AD (Sampura, 1968, 87). On the coast of Miyani a temple dedicated to Goddess (locally known as Harshadmata) is situated on a high hill. A vast creek known as Meda creek runs a few miles in hinterland area, which has been used as a sheltered harbour for the country craft, particularly fishing vessel. The coastal area is consisted of plain sandy beaches except a high hill over which a temple of Goddess is situated.

Underwater explorations have been undertaken about 1 km offshore of Harshad Mata temple. The seabed comprises of sandy channels and rocky outcrops. There is not much vegetation growth noticed. Several places small gravels were also noticed. Sand is comprises of clayey element which makes visibility very poor. Twelve artifacts were discovered from here.

2.2 Visawada

The small town of Visawada lies about 40 km west of Porbandar and about 20 km east of Miyani. The Hindu pilgrimage center and a temple dedicated to the Lord Krishna, is situated in the middle of the town. A creek (known as Kindari Creek) runs to a long distance at least up to Kindar Kheda (a Harappan town) and perhaps Kindari name derived from this particular ancient town. The western side of the coast is represented by a high cliff while the eastern coast is consisted of sandy beach.

Explorations have been undertaken off Kindari Creek about 500 m from coastline. Seabed topography is consisted of sandy channels and rocky outcrops. At several places small boulders and dense growth of vegetation was observed. Water depth varies between 8 to 5 m, however, archaeological findings were
concentrated between 5-6 m water depths. Total 14 stone anchors have been found and they represent by three varieties known as composite, Indo-Arabia and ring stone types.

2.3 Kindar Kheda
The village Kindar Kheda is situated about 20 km northwest of the present town of Porbandar and it is approachable by road from Porbandar. Archaeological site is under cultivation and located on the eastern side of village. On the site a Sun (Surya) temple dating back to the 9th century AD (Sampura, 1968, 91-92) of post Maitraka period is situated. A low lying area was observed on south of the site.

The coastal archaeological exploration around Porbandar has been rewarding by the findings at Kindar Kheda. The archaeological findings such as pottery and stone tools suggest that this is a protohistoric site (late Harappan) dating back to the 2nd millennium BC. The pottery types very compare well with those reported from other protohistoric sites at Bet Dwarka (Gaur and Sundaresh, 2003, 57-66) Nageswar (Hegde et al., 1990, 15-36), Porbandar (Gaur, et al., 2004, 103-107), and Rojadi (Possehl and Raval, 1989, 57-140). Discovery of a stone anchor (Figure 2) and other shell artifacts suggest the adoption of maritime practices as in the case of other Harappan sites along the Saurashtra coast. Study of an ancient map indicates that topography has changed significantly between Kindar Kheda and Porbandar and Kindari Creek. As per the study of ancient map Kindar Kheda was approachable by boat at least up to 1856 (Gaur and Sundaresh, 2005, 44-48). The study of sea level fluctuation suggests that during Harappan time sea level was higher than the present (Merh, 1992, 471). Archaeological, geographical and geological data suggest that Kindar Kheda might have been an active protohistoric and historical period port on the Saurashtra coast.

2.4 Somnath
The archaeological excavations on land at Prabhasa by the Baroda University and Deccan Collage Pune have yielded evidence of a township of 2000 BC. The temple of Somnath nearby is dedicated to Lord Siva and the linga is counted among the 12 Jyotirlingas of India mentioned in various Puranas.

The Prabhasa - Somnath coast forms a straight line revealing a vivid manifestation of marine aeolian and fluvial processes that have resulted in a number of important geomorphic land forms, as the near shore zone is characterized by the formation of recent alluvium deposits, sand bars, mud flats and mangroves swamps. The coastal zone is covered with beaches and littoral sand, oyster beds and sand dunes.

The explored area in Somnath water is located at a distance of 400 m south-west of the Somnath temple. The study area is comprised of rocky out crop and sandy patches. During the first season 6 objects, second season yielded 8 objects and present season 2001 yielded 21 ring stones. Somnath waters witnessed the occurrence of the largest number of ring stones. Out of 43 total discovered stone anchors, 80% belong to ring stone category. The water depth varies from 7 m to 15 m. The ring stone (Figure 3) noticed in less than 8m water depth and the growth of seaweeds also noticed, however ring stones of deeper depths have a layer of greyish marine growth.
2.5 Kodinar (Mul Dwarka)

A small coastal village known as Mul Dwarka near Kodinar in the district of Junagad is one of the claimant of the original Dwarka of Mahabharata. The proximity with Junagadh hills on the north and sea on the south the town has been associated with Dwarka (Sankalia, 1966, 7). An ancient temple is situated on a raised land close to the sea. The temple is in dilapidated condition and is not under worship. The shrine is dated to the post 10th century AD (Sampura, 1968, 113). A circular structure of about 4 m in height constructed with similar type of dressed limestone blocks as of the temple in situated close to ancient temple. Locally this structure is called as Diva Dandi (lighthouse). If this structure has served as lighthouse (Figure 4) then this may be the oldest remains of lighthouse on the Saurashtra coast. Local fishermen informed that a few anchors similar to those of Indo-Arabia type were present but now they have either buried under new port or other private buildings, which cannot be noticed. An ancient well was noticed which is still used for drinking water source near the jetty.

The exploration in inter tidal zone yielded a composite stone anchor. The anchor gets exposed during low tide. It is made of sedimentary rock. The anchor has an upper circular hole and lower two holes are square. The upper portion is semicircular and edges are sharp. The thickness of anchor gradually increases from 12 cm at upper end to 20 cm at lower end. The anchor is similar to those reported from Dwarka (Gaur, et al., 2008, 23-57) and Bet Dwarka (Gaur et al., 2005, 113-129) and dated between the historical and the medieval periods.

The offshore exploration in Mul Dwarka region revealed uneven rocky and sandy patches as major observation of seabed topography. The exploration revealed a few stones possibly used as anchors for small boats but they are not similar to those anchor found from inter tidal zone of Mul Dwarka and other places on the Saurashtra coast. There is possibility that ancient anchoring point might have been vanished during the construction of new jetty.

Mul Dwarka, the third site, which has been considered as Dwarka of Mahabharata period has been surveyed extensively for any submerged archaeological remains. The remains of ancient port of Mul Dwarka have been destroyed due to the construction of cement jetty. However, discovery of a composite stone anchor and report on some grapnel type anchors from Mul Dwarka suggest that this was also an active port town during the historical and medieval periods. An ancient lighthouse may be dated to the 12th-15th century AD may be another indication of active maritime activities in this region. A tidal river, which has been blocked due to a sand bar (may be due to the construction of cement jetty) flows western side of Mul Dwarka village. Archaeological findings from Mul Dwarka suggest that this was a historical period settlement and was very active port during the medieval period.

The underwater investigations in and around Mul Dwarka (Kodinar) have been of significant in respect of understanding the archaeology of this region. Now the data of underwater explorations from all the three Dwarka on the Saurashtra coast are available and the most common aspects of them is the present
of similar type of stone anchors, therefore, the tradition of Dwarka at these places might have been existed at a same time (in the Early Medieval Period). Another common aspect of these sites is the presence of Harappan and late Harappan settlement within close proximity, for example, Nageshwar and Bet Dwarka near Okhamandal Dwarka, Kindar Kheda near Mul Dwarka (Visawada) and Kanjetar and Kaj near Mul Dwarka (Kodinar). All the three Dwarka have ancient temples dated to the 10th -12th century AD. Nonetheless, these sites were ancient busy ports and perhaps temples were served as coastal marker point for navigator and also they worship before embarking on the long voyage.

2.6 Mithi Virdi

The small village Mithi Virdi is situated about 30 km south east of Talaja, a taluka, headquarter. The village is lying on a raised plateau close to the seashore. A small seasonal river merges with the sea on the western side of the village. Archaeological site is located about a km west of the village in an agriculture field. The area is comprised of reddish soil with small quartz gravel signifying the flow of the river channel from this area.

Five stone anchors are lying in an agricultural land (ground nuts are the important crop of this field) about 1 km north of the seashore. Three anchors are lying together at a distance of 10 m and oriented in the east-west direction. One anchor is in a broken condition. The fourth anchor is laying partially buried north of the other three and oriented in the east west direction.

All the anchors are similar to each other in shape and sizes. The anchors have rectangular cross-sections and trapezoidal longitudinal sections (Figure 5). These have sharp edges and chisel marks on them are clearly noticed. They have been cut from conglomeratic sedimentary grit rock, which is dark brown in colour and small gravel can be noticed. The anchors have only lower two rectangular holes and upper circular hole is absent in all the anchors. Brief description of each anchor is given below.

2.7 Gogha

The town of Gogha is located on the mid western coast of the Gulf of Khambhat in Bhavnagar district of Gujarat. A famous Gujarati proverb “Lankani lari ane Ghoghono var” (Bride of Lanka and groom of Goghra) indicates direct overseas relation between Gogha and Sri Lanka in the past (Chaukasi, 1989, 634). The presence of ancient Jaina temples at Gogha dating back to the 10th –11th centuries suggest that this was a religious center also. The earliest Arabic inscription from Gogha dates to 1170 AD (Oza, 1885, 2). During the British period ships up to 1500 tons were laden here (Habib, 1982, 23).

The exploration at Gogha was undertaken during low tide and findings were recorded with still photography and drawing. A large number of stone anchors were recorded between 100 and 200 m distance from the high water line. The majority of the anchors belong to the Indo-Arab type and nearly about 40% anchors are fragmented. Interestingly, the fresh surface of broken part suggests that fragmentation of the anchors took place during the manufacturing stage and not during the anchoring
processes. A composite anchor made of lime stone is another noteworthy finds from the site. A few anchors unfinished were also found from Gogha and Hathab. However, these anchors submerge in 5 to 7 m water depth during high tide. Thus, it indicates that big boats were anchoring at this point during high tide. The author of the Periplus of the Erythrenean also refers that during low tide boats rest on the seabed.

The exploration in inter tidal zone has also yielded several sherds of the glazed ware (Figure 6 & 7) in the vicinity of stone anchors. These include a jar (Figure 8) with internally and upper half externally glazed and rests of the sherds are glazed only internally. There are three main type of glazed ware i.e. green, blue and brown. These are very similar to the Islamic glazed ware found from various parts of the country (Mohammad, 1985, 105). The medieval period glazed ware at Hastinapur (Lal, 1954-55, 5-151) was found in association with coins of Balban (1206-87 AD). The sherds recovered from the inter-tidal zone of Ghogha are very similar to those reported from another medieval period site at Lashkarshah in Khambhat which have been dated to 14-16th century (Bhan, 2006, 90-95). Thus the glazed sherds Ghogha may also be dated to the late medieval period.

2.8 Hathab

Hathab an early historical site finds mention as Astacampra in the Periplus of Erythrenean Sea (Schoff, 1912, 40). On shore excavation yielded rich antiquities of the historical period and maritime contact with the west. It is located about 1 km in hinterland. The exploration in inter tidal zone of Hathab yielded 2 anchors similar to those of Indo-Arab type and one anchor with a wide groove surrounding in middle of the anchor (Figure 9). This is very similar to those reported from Japan and Chinese waters.

2.9 Harappan sites at Budhel and Sultanpur

Budhel a late Harappan site is situated about 20 km southwest of Bhavnagar. The site is extended in a large area that is partially covered with Mohammedan graveyard and remaining part is under cultivation. A small seasonal stream is flowing close to the mound and merges in the Gulf of Khambhat near Gogha. Another Harappan site known as Hanuman-no-Timbo is situated in the estuary of the river Shetrunji near Sultanpur in Talaja taluka. A modern road divides the site into two. On the western side the mound is very high while as on the eastern side the mound is low which is just banking the river Shetrunji. The site is extended approximately over a km in length and half a km in width. The entire site is surrounded with a low lying area, which may be the remains of a tidal channel inundated during the spring tide in the 3rd millennium BC. A large number of pottery including perforated jar painted pottery were noticed from site during the exploration. It was interesting to note that the fishing boats are reaching very close the site during the high tide. Thus the site has potential to be an ancient port town of Harappan period (Gaur and Bhatt, 2008, 99-104).

The remains of a jetty were notice at the mouth of the river Shetrunji near the village Sultanpur. This was primarily a wooden jetty now abandoned due to emergence of other ports in the vicinity. As per
information received during the discussion with local resident the jetty was built about 100 years before and it was abandoned in the early seventies.

2.10 Gopnath

Gopnath serves as the entry point to the Gulf of Kambhat. The coast is marked with high cliffs, rocky and sandy beaches. Being close to the Gulf the tidal range is very high and a large area gets exposed during low tide. A large number of broken sculptures can be noticed in inter tidal zone area. An Indo-Arab type of stone anchor has been reported at the lowest water line and gets exposed during the low tide of new moon day. It is complete in shape and made of hard basaltic rock (Figure 10). It has two lower square holes and upper hole is circular in shape. The length of this anchor is 2.2 m. It is lying about 2 km offshore from high waterline.

2.11 Vallabhipur

Vallabhi has been described as one of most famous Universities of ancient India, is situated on a seasonal stream merging on the western bank of the Gulf of Kambhat. Topographical location suggests that the river must have been a tidal creek in the past. Ancient site is just located on the bank of Vallabhi river. According to the tradition boats used to come up to the site from sea about few decades earlier, but now it has been completely silted up.

While an onshore exploration around Vallabhi it was informed that two anchors were lying near present bus stand and those were recently shifted to the Taluka Office. Then Taluka Office of Vallabhipur was visited and those two artifacts are lying open. These are channel marker buoys and made of iron. No information is available in the Taluka office about their uses and period. However, with observation and comparative studies suggest that these artifacts are the British period buoys for channel indicators. Discovery at Vallabhipur indicates that during the British period ships/boats used to come up to the Vallabhipur and later on river has been silted up and presently shoreline is about 4 km away from Vallabhipur. With this reference it may be argued that rapid shoreline change must have affected the function of the historical and medieval period ports around the Gulf of Kambhat.

3.0 Discussion

Coastal and underwater archaeological explorations along the Indian coast, during last two decades have yielded a large amount of data on the existence of ancient ports, jetties and anchoring points. In the last case we refer to places where vessels are known to have moored i.e. to sit at anchor offshore. An important artifact for identification of a port and anchoring point is the anchor itself, and usually these are lost having parted from the parent boat through a break in the cable or other accident such as being abandoned due to the sudden onset of storms or being caught on the seabed. These lost anchors are amply found all along the Indian coast.
The present paper then deals with some elements of the underwater archeology of ports, jetty and anchoring points along the Indian coast with special mention of the Gujarat coast as an example of the nature of this resource. The important antiquities mentioned include underwater and onshore timber and stone structures and stone anchors recovered during the marine archaeological explorations. A comparative study has also been made with modern traditional jetties found all along the Indian coast.

3.1 The role of tidal range in construction of jetty

The study of the existing traditional jetties along the west coast of India suggests that Gujarat coast does not have jetties built of wood while going down to Maharashtra and Karnataka coast, wooden jetties are found, many still operational, particularly in backwater areas where they are by local fishing trawlers and canoes. Indeed, the presence and absence of a jetty at a recognized port could well be connected with tidal variations as Gujarat coast by and large experiences a higher tidal range and the gulf areas further more. The tidal curves of Okha and Porbandar, for example, suggest a comparatively higher tidal range of 0 to 4 m and 0 to 3 m respectively whereas the southwestern coast of India has lower tidal range of 0 to 2 m at Karwar and 0 to 1 m at Cochin (Indian Tide Table, 2010). Where the higher tidal range results the exposure of a larger beach area, it is apparent that jetties are not necessary. After anchoring offshore to await the incoming tide, fishermen take their boat as far inshore as possible right up to the high water line during the high tide. During low tide, as the water recedes their boats rest on the sandy beaches and they carry out loading and unloading and also small repairing of boats, if necessary, without needing any kind of structure. This appears to be a very old tradition in Gujarat, as a large number of stone anchors from inshore as well as inter tidal zones of Dwarka, and Bet Dwarka, and one each at Armada, Tukda, and Gopnath have been recorded. However, moving down the coast the tidal variations reduces significantly and falls in the range of 1 to 2 m. This does not allow the large exposure of land low water. Where there is minimal tidal range, the boats need to be continuously afloat, necessitating a landing as well as loading and unloading points. In these cases timber jetties provide as affordable solution. Tidal currents need also be considered in these circumstances, for it weak the can often not be strong enough for the boat to propel back to the sea, especially if it lies on the shore and the breezes are contrary.

3.2 Structure of wooden jetty

A jetty is fashioned by employing a trestle arrangement similar to that of a light- weight bridge on a small river by using the strong forest wood. Normally piles are sunk vertically into the seabed or into a rock support. The selection of wood log is depended on its straightness. The distance between pair is normally 0.5 m, which allows at least two planks of 0.25 m width rest between pairs. The distance between two rows varies from 0.75 m to 1.5 m. On the two rows, wooden planks would be resting that is used for loading unloading of the vessels. This type of jetties has been noticed right from Ratnagiri in the north to Kerala in the south.
3.3 Anchoring Points along the Saurashtra coast

To approach a port in the creek, often ships or boats use to anchor at open sea where creek merges with sea as well as at suitable water depth. Generally, the anchoring points have a rocky seabed as an anchor need to hold the boat firmly. The underwater investigations on the Saurashtra coast have clearly demonstrated that ancient anchoring points were in water depth of 5 to 7 m. These observations well correspond with the depth of the traditional anchorage points all along the Indian coast. The underwater observation revealed that seabed topography between Bet Dwarka on the extreme west and Somnath on the east, is almost less variant particularly at Dwarka, Miyani, Visawada, Porbandar, Tukda and Somnath. The seabed topography is comprised of the rocky formations with numerous channels filled with fine sand. The stone anchors were trapped in these channels and between the rocks, which were suitable for holding big boats like Arab *Dhows* and Indian *Vahan*. The observation at Bet Dwarka and Porbandar revealed that boats of carrying more than 100 tons of cargo are anchored in a water depth of 4 to 5 m and some time they are resting on the sandy beaches during low tide. Exception at Somnath has been observed that most of the anchors are reported from 8 to 12 m water depth that indicates the anchoring point at Somnath was in comparatively at deeper depth. This phenomenon could well be connected with low tidal variations at Somnath, where boat needs to continuously float. However, the majority of these anchors belong to ring stone type.

The port plays a dominant role in facilitating the sea trade and there were several ports all along the India coast since antiquity. The prerequisite of the selection of any port site include a sheltered place particularly protection from high wind and rough seas, sufficient water depth for sailing the vessel and a suitable anchoring point. Besides structural part of the port, it is also important to keep in mind that the enough products from the hinterland reach to the port and from the port to hinterland. The majority of the ancient ports were situated on the river banks and the back waters. A few Harappan sites including Kuntasi (Dhavalikar et al., 1996, 5), Amra, Lakhawavel and Vasai (Rao, 1991, 152) on the northern Saurashtra coast are located on the banks of tidal rivers where tidal variation is as high as 5 m that helped mariners to reach up to the site during high tide.

The archaeological findings have indicated that the existence of several ports, jetties and anchoring points along the west coast of India from the protohistoric period (Ray, 2003, 2). The discovery of a large number of stone structures and anchors at Dwarka suggests that it was a busy port during the historical and the medieval times (Gaur, et al., 2008, 61). They have profusely used large limestone blocks for its construction. Whereas, addition to stone block wooden logs were used for a later period jetty at Rupen *Bandar*. Though there is no remains of an ancient jetty at Bet Dwarka the presence of the stone anchors in inter tidal zone indicate that the high tide was effectively used for beaching the boats. Conversely, the northwest coast of India has jetties in creeks, which are made of limestone blocks while southern side traditional wooden jetties continued to be in use.

The tidal variation and seabed topography played a significant role in construction of jetties. As stated earlier, that the higher tidal variation in Gujarat has been used by the navigators to anchor the boats in
inter tidal zone and loading unloading of boat become easier. It has also been confirmed with the
discovery of stone anchors from inter tidal zone areas of Dwarka, Bet Dwarka and Armada. The stone
anchors are the indicator of the ancient anchoring points and underwater findings have indicated that the
preferred anchoring points on the Saurashtra coast falls between 5 and 7 m water depth.

4.0 Conclusions

The findings from coastal and underwater investigations on the Saurashtra coast have indicated that the
mouth of the various creeks has vast potential for underwater archaeology. The tidal variation and
seabed topography played a significant role in construction of jetties. The higher tidal variation in
Gujarat was used very effectively by the navigators to anchor the boats in inter tidal zone and loading
unloading of boat become easier.

The coastal archaeological explorations along the western coast of the Gulf of Khambhat yielded the
remains beginning from the Harappan times to the modern time. Tidal range has been the major
attraction for the continuous settlement, which facilitates movement of boats without much energy in a
given particular time. Budhel and Hanuman-no-Timbo are important Harappan sites situated along the
Gulf and Vallabhi and Hathab are noteworthy sites of the historical period. Gogha was the most
important port during the medieval as a large number of stone anchors have been recorded from inter
tidal zone. The majority of the anchors fall in the group of Indo-Arab type and they have been dated
between the 10th and the 14th century AD on the basis of finding of the Islamic glazed ware along with
the anchors. Similarly, anchors have been reported from Hathab and Gopnath. The most interesting
anchor includes a Chinese type datable to the 12th-14th century.

The Kodinar region is rich in archaeological remains as two Harappan period sites are located at
Kanjetar and Kaj respectively. Similarly, historical period remains have been traced at Kaj and Mul
Dwarka. The discovery of amphorae sherds from Kaj indicate that another settlement with Roman trade
was situated between Bet Dwarka and Hathab as these two sites have been mentioned in the Periplus of
the Erythrean Sea. Perhaps this lost the importance as a port during the medieval period when
Veraval, Mul Dwarka and Div emerged as leading trade centers. Another site of late historical and early
medieval period at Chhara has interesting location and part of it submerges during the highest high tide.
The evidence suggest that coast has gone under change during early medieval period may be due to sea
level changes. Marine archaeological investigations in and around of Mul Dwarka region has yielded the
remains stone anchors at Chhara, Kanjetar and Mul Dwarka, which indicate that during the historical
and the medieval period these were active maritime trade centers. It will worth to mention the discovery
of a medieval period lighthouse on the shore of Mul Dwarka.

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Table 1: Stone anchors from various sites along the Gujarat coast

<table>
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<tr>
<th>Site</th>
<th>Composite anchors</th>
<th>Indo-Arabia type anchors</th>
<th>Ring stone anchors</th>
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**Note (1):** A few scholars (Shah, 1960:310-20; Leshnik, 1968:911-22; Pandya, 1977:99-103) have contested the identification of dockyard as not being a real dockyard but drinking water pond or irrigational tank.
Figure 1. Archaeological sites along the Saurashtra coast

Figure 2. Stone anchor found at Kindar Kheda
Figure 3. Ring stone anchor found in Somnath waters

Figure 4. Medieval period light house at Kodinar
Figure 5. Biggest stone anchors noticed at Mithivirdi, Gujarat.

Figure 6. Medieval period Blue glazed pottery from Ghogha
Figure 7. Medieval period brown glazed pottery from Ghogha

Figure 8. Large glazed vessel found in Ghogha area
Figure 9. Chinese type stone anchor from Hatab

Figure 10. An Indo-Arab type anchor exposes during the lowest low tide off Gopnath