

# **Tsunami Survey at Kanyakumari**

**Report on field survey at Kanyakumari**

**December 2007**





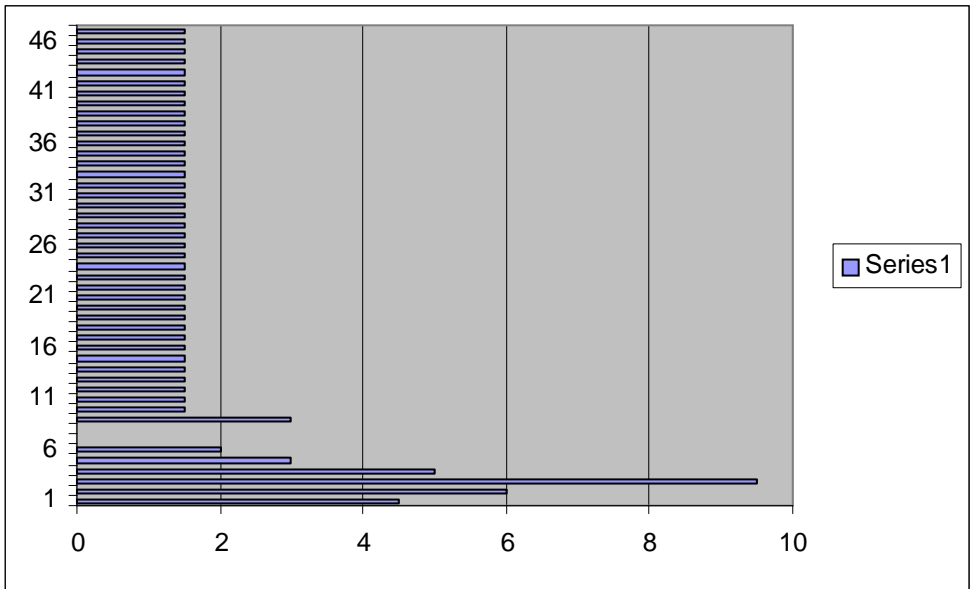
Map 2. Town of Kanyakumari

**2.0 The Inundation Survey:** The penetration of tsunami waves inside the shore is an indication of the level of destruction. Collection of such data helps in planning of future mitigating measures. For this purpose, the entire coast of Kanyakumari was surveyed. The team consisted of following persons.

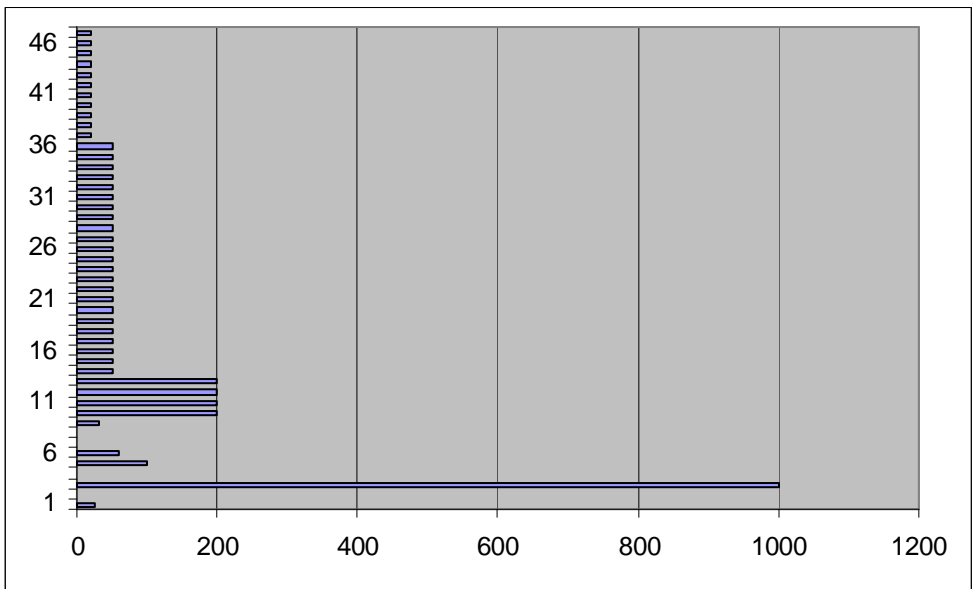
- (1) Dr. Arun Bapat, Expert, Tsunami
- (2) Shri. V.S. Patil, Dy. Director, NSCI
- (3) Shri. P. Gunasekaran, Safety Officer, Heavy Water Plant, Tuticorin and Project Manager

Three postgraduate students assisted the team.

The team traversed the entire coastline of about 4.8 km length. The locations were selected at 50 m interval. The locations of the survey points were noted by a GPS and these locations have been given in Table1. At each location, whenever possible some persons were interviewed and information from them was recorded. The details of interview are shown in Annexure I. The data were analyzed and are presented in Graphs. The Graph 1 shows the heights of tsunami at different locations and Graph 2 is for inundation.



Graph 1. The height of Tsunami at different locations. Observation Points on Vertical axis and Tsunami height (m) on horizontal axes.



Graph 2. Inundation at different points. Observations Points on vertical axis, inundation (m) on horizontal axis.

**3.0 Discussion and Conclusions:** The Table, graphs and photos give lot of information about the tsunami. The main points of the survey are:

- (a) The tsunami height at majority of the points along the Kanyakumari was about 1.8 m
- (b) At locations 1 to 9 the heights were in the range 3 to 9.5 m
- (c) The Kanyakumari shoreline appears to have experienced tsunami up to 1.5 m. The Vivekananda Rock Memorial and the Thiruvalluvar Statue might have given some partial protection. The tsunami waves hit these two locations first and then arrived at Kanyakumari shoreline.
- (d) The inundation varies from 50 m to 1000 m. It was about 200 m at locations 14 to 36 and about 50 m at points 37 to 46. At some locations where tsunami height was up to 1.5 m and inundation was just 200 m a number of fishermen are staying and large number of fishing boats are anchored at this location. At these and similar locations where extensive inundations have been observed it is recommended that Gabions may be placed. The Gabions are discussed in Appendix – II. These are wire cages filled with stones of about 25 to 30 kg weight. The Gabions provide useful protection.
- (e) The present report is based on field observations. It is recommended that a computer tsunami model may be developed for minute understanding of the tsunami process at Kanyakumari. Developing such a model may take some time but it will be useful.
- (f) Useful field observation: While surveying the team has observed a young coconut tree. The colour and mark on the trunk of tree show the mark of tsunami. This is shown in Photo 1.  
  
A middle age lady Mrs. Muttama Palmani age about 50 years, was hit by Tsunami and she got stuck up on a tree. Her nephew Selvaraj was also washed away and got stuck up at another tree. See Photo no. 2 and 3. This observation was useful in arriving at the height of tsunami.
- (g) A church shown in Photo 4 has been repaired and this also shows the height of tsunami at that location.
- (h) In addition to the placing of Gabions, suitable pre-tsunami warning mechanism may be worked out. In addition to the announcements on radio and television, it would be most effective if the tsunami warning were sent by SMS. At present it is possible to send SMS by one operation to about 3000 to 5000 Cell phone users. Suitable mechanism may be worked out with Cell companies.

- (i) Creation of awareness about tsunami may be taken up as a part of school and community learning activities.
- (j) Kanyakumari is about 130 to 150 minutes away from the probable epicentral locations in Indonesia. If a Tsunamigenic earthquake occurs in Indonesia, it will be known through various websites and through telephone contacts. The Tamil Nadu state Disaster Management should establish contacts with Andaman and Nicobar (A & N) Administration. Indonesian Tsunami may hit Andaman within about 20 to 30 minutes. The A & N should immediately inform the District Collector of Nagercoil.
- (k) Periodic assessment of the situation may be routinely undertaken every six months. This will help in reviewing the progress and also help in modifying the mitigation measures. A suitable permanent committee for this purpose may be formed.

**Table 1: Details of observation points, GPS Position, tsunami height, inundation and remarks.**

Location No.	Latitude (N)	Longitude (E)	Tsunami height (m)	Horz. Inundation (m)	Remarks
01	08° 04.714'	077° 31.895'	4.5	25	Sun set Pt
02	08° 05.403'	077° 29.035'	6	On back water	Keelamanakudi Bridge
03	08° 05.416'	077° 28.588'	9.5	1000	Sothavilai Beach
04	08° 04.761'	077° 32.430'	5	Nil	Old Beach Road
05	08° 04.678'	077° 33.067'	3	100	16 Pillar Mandapam
06	08° 04.896'	077° 33.165'	2	60	Boat Jetty
07	08° 06.134'	077° 32.952'	-	-	Kumarisalkulam. (Panchayat limit on North side)
08	08° 07.577'	077° 33.914'	-	-	Vattakottai (For Ref.)
09	08° 05.654'	077° 33.835'	3	30	Chinnanuttym Muttom (CM)Temple. (KKTP limit Starts on East Beach)
10	08° 05.541'	077° 33.840'	1.5	200	50 m from CM
11	08° 05.525'	077° 33.814'	1.5	200	100 m from CM
12	08° 05.520'	077° 33.789'	1.5	200	150 m from CM
13	08° 05.510'	077° 33.766'	1.5	200	200m from CM
14	08° 05.505'	077° 33.743'	1.5	50	250 m from CM
15	08° 05.498'	077° 33.718'	1.5	50	300 m from CM
16	08° 05.491'	077° 33.694'	1.5	50	350 m from CM
17	08° 05.483'	077° 33.672'	1.5	50	400 m from CM
18	08° 05.477'	077° 33.650'	1.5	50	450 m from CM
19	08° 05.469'	077° 33.630'	1.5	50	500 m from CM
20	08° 05.463'	077° 33.609'	1.5	50	550 m from CM
21	08° 05.453'	077° 33.588'	1.5	50	600 m from CM
22	08° 05.438'	077° 33.568'	1.5	50	650 m from CM
23	08° 05.423'	077° 33.549'	1.5	50	700 m from CM
24	08° 05.412'	077° 33.531'	1.5	50	750 m from CM
25	08° 05.402'	077° 33.508'	1.5	50	800 m from CM
26	08° 05.391'	077° 33.486'	1.5	50	850 m from CM
27	08° 05.379'	077° 33.467'	1.5	50	900 m from CM
28	08° 05.366'	077° 33.449'	1.5	50	950 m from CM
29	08° 05.351'	077° 33.425'	1.5	50	1000 m from CM
30	08° 05.341'	077° 33.405'	1.5	50	1050 m from CM
31	08° 05.331'	077° 33.383'	1.5	50	1100 m from CM
32	08° 05.313'	077° 33.362'	1.5	50	1150 m from CM
33	08° 05.297'	077° 33.338'	1.5	50	1200 m from CM
34	08° 05.274'	077° 33.319'	1.5	50	1250 m from CM
35	08° 05.254'	077° 33.299'	1.5	50	1300 m from CM

36	08° 05.233'	077° 33.282'	1.5	50	1350 m from CM
37	08° 05.209'	077° 33.272'	1.5	20	1400 m from CM
38	08° 05.184'	077° 33.259'	1.5	20	1450 m from CM
39	08° 05.168'	077° 33.213'	1.5	20	1500 m from CM
40	08° 05.072'	077° 33.143'	1.5	20	1550 m from CM
41	08° 05.039'	077° 33.137'	1.5	20	1600 m from CM
42	08° 05.010'	077° 33.142'	1.5	20	1650 m from CM
43	08° 04.985'	077° 33.139'	1.5	20	1700 m from CM
44	08° 04.957'	077° 33.130'	1.5	20	1775 m from CM
45	08° 04.934'	077° 33.125'	1.5	20	1850 m from CM
46	08° 04.908'	077° 33.117'	1.5	20	1925 m from CM
47	08° 04.759'	077° 33.083'	1.5	20	2000 m from CM
48	08° 05.286'	077° 32.819'	-	-	Railway Station (For Ref.)
49	08° 05.235'	077° 32.672'	-	-	Pillar Hospital Road (For Ref.)
50	08° 05.539'	077° 32.610'	-	-	South Kundal Village (Panchayat Border)
51	08° 06.092'	077° 32.456'	-	-	Microwave station (For Ref.)
52	08° 06.135'	077° 32.491'	-	-	Nagarcoil KK Road
53	08° 06.287'	077° 32.393'	-	-	KK Fire Station
54	08° 05.733'	077° 31.683'	-	-	Railway Crossing
55	08° 04.918'	077° 32.586'	-	-	KK Bus Stand
56	08° 04.911'	077° 32.660'	-	-	St. Michel Community Center for Shelter
57	08° 04.896'	077° 33.021'	-	-	Panchayat Office

## Appendix - I

The team started the field survey work on 17<sup>th</sup> Dec 2007. Dr. Tad Murty from Ottawa University Canada accompanied the team on first day. The Field Survey is confined to the Municipal limits of the Kanyakumari town and is at the shoreline of the town. The length of the shoreline at Kanyakumari is about 4.8 km.

The Tsunami Survey commenced at Sunset point GPS Location 08° 04.714' N and 077° 31.895' E. The observations are as follows.

Mr. J. Anthony, age 75, Fisherman. Observations

- (a) First wave at 0930 and then sea water receded by 4.0 to 5.0 km
- (b) The boat was washed away by waves
- (c) Sea water came up to horizontal distance of 10 m from the current tide line, height 4 to 5 m
- (d) After tsunami the sea water had a bad smell and it caused allergy with blisters

Mr. Domni, age 40, Fisherman. Observations.

- (a) 0800 small wave. At 1000 hrs sea receded
- (b) The big wave came at 1015 height 5 m
- (c) Previous day high fish catch
- (d) After Tsunami fish catch was reduced
- (e) They were warned by continuous ringing of church bell
- (f) Rise in skin disease after tsunami

Mr. Christraj Kennedy, Age 45, Fisherman. Observations

- (a) 0800 slightly higher wave than normal arrived
- (b) 1000 sea receded up to 2.5 km
- (c) 1115 large wave hit the shoreline

The second point of observation was at Keelamanakuda (East Manakkudi) GPS Location 08° 05.403' N and 077°29.035' E The observations are as follows.

At this site there was a prefabricated bridge of two segments of 30 m length each resting on 4 pillars and the side bunds having a span of 15 m each. The two segments were dislodged by the tsunami. The western segment was thrown upto 30 m towards the western bank and the other was thrown to about 8 m on the eastern side. (see photo No.)

On the western side of the bridge, inside a house compound, a cocoanut tree has some discoloration up to a height of 6 m. This mark could be correlated to tsunami height at that location (plus ground height of about 3 m).

The third point of observation was at Sothaivavilai Beach GPS Location 08° 05.416' N and 077°28.588' E The observations are as follows.

Mrs. Mutthammal wife of Mr. Palmani age 48. Observations are:

- (a) She was having a thatched shed, which can accommodate 20 persons and was serving breakfast and lunch.
- (b) At 0610hrs water came up to the road. At 0810 slightly higher wave observed. At 1100 hrs the sea receded up to 3 km.
- (c) At 1120 hrs huge water wave hit. She was lifted, her head hit a lamppost and she lost her tooth. She became unconscious and was stuck up at a top of a palm tree situated about 10 m from her shop. Her sister's son Silvaraj age about 30 yrs. was also washed away and stuck up at a cocconut tree located at about 25-30 m from the shop. Her husband was in bathroom and could not move out and had suffered injuries. Both of them were in hospital for 42 days (wife) and 45 days (husband).
- (d) After about 20 minutes the water level came down. Selvaraj shouted for help, people came and rescued both of them. The heights of the both the tree are positively indicative of the tsunami height of about 7-8 m (plus ground to sea level of 2 m)
- (e) The tsunami height is corroborated by the corrosion of the electrical fittings on the nearby lamppost.
- (f) The spiral staircase of the sun set view tower in that location was washed away and the water level was up to the bottom brim of the flooring. It is understood a person was on the top of the tower jumped in to the water. His body could not be retrieved.
- (g) In the Manakkudi village enroute to the Beach a Church located at about 2m above sea level has undergone repair about 6 m from ground through out the sea side wall.

The fourth point of observation was at 100 m east of KW001 GPS Location 08° 04.764' N and 077°32.430' E near Kamaraj Mandapam. This has been identified as KW004. The observations are as follows.

Mr. Perumal, age 35, street side goggle seller. Observations are as follows:

- (a) He saw waves at 0600 hrs, 0900 hrs and 1100 hrs. The wave at 0900 hrs receded about 2km. The tsunami height at this location was about 5 m.

The fifth point of observation was at sixteen-pillar mandapam. GPS Location 08° 04.678' N and 077°33.067' E near Kamaraj Mandapum. This has been identified as KW005. The observations are as follows.

Mrs. Joyce Mery, age 39, fruit seller. Observations are:

- (a) At 0700 seawater receded to 500 m.
- (b) First wave came at 0930 up to mandapam. Next wave came from Thiruvalluar Statue to Bhagavati Amman Kovil (temple). Third wave came at 1200 hrs. The wave height 3 m.

Observations from Mr. Krishna Pillai, President of Taxi Owners' Association:

- (a) On 26 December'2004 at 0900 he saw people were crying and running and this number was rapidly increasing. He saw crowd at Vivekanand rock memorial from Sea View Hotel. His relative and friends in Andaman and Chennai telephoned him that the sea is unusually rough.
- (b) At around 0945 sea started receding, there was no water between the jetty and Vivekanand Rock Memorial and Thiruvalluar Statue. Similar situation had never occurred in the past.
- (c) Around 1100 large sea waves started hitting the coastline. This has destroyed number of ships and other structures. The waves continued to hit for about 20 to 25 minutes. The whole act lasted for about two and half hours.
- (d) One boat at Kanniyakumari jetty was swept away and was found after two months at Earnakulam.

Observations by Mr. C. Swarnapandian, Manager, Phoompuhar Shipping Corporation (Govt. of Tamilnadu Enterprise):

- (a) On 25<sup>th</sup> December'04 at around midnight 0200 hrs. it was reported by the security guard that a powerful wave hit the coast and small boats were damaged.
- (b) His son informed him on telephone about rough sea at Chennai. Immediately he went out and saw seawater was highly muddy than the normal condition and the wave heights were also more than the average at about 0900 hrs.
- (c) He immediately stopped the ferry, which was about to start. The shipping corporation has two ferryboats.
- (d) At 0945 hrs the first sea wave from east arrived. This was followed by several waves of rising heights. The most powerful wave of 8.0 m height occurred at 1110 hrs.
- (e) Both the ferryboats were lifted up and were placed on the jetty.

## Information about Gabions

Gabions provide a simple bank protection technique. This consists of a nylon wire cage usually of 1 x 1 x 1 cu.m size. This cage is shown in Fig. G1 below:

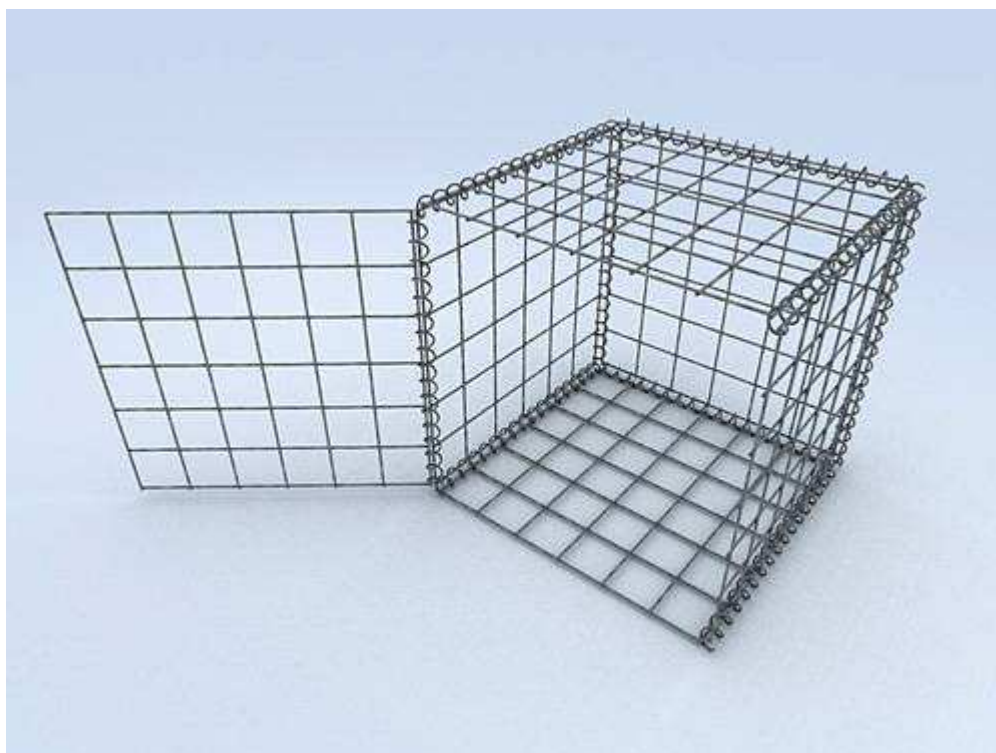


Fig. G1: The wire Cage of Gabion

The nylon rope diameter is usually between 8 to 12 mm sizes. The size depends upon the tidal force and tidal range. The difference between high tide and low tide is known as 'Tidal Range'. At Kanyakumari the Tidal Range is 0.6 meters. Considering these factors, about 10 mm nylon ropes may be suitable. This cage is prepared and placed at the site of installation. This cage is then filled with stones of weight between 25 to 30 kg. After the cage is filled with stones the lid side is sewed and the Gabion is placed at the shore protection area. If required and depending up on the geometry of the shoreline, the Gabion size could be 2 m (length) x 1 m (height) x 1 m (width). During course of time and due to the tidal action the voids in the Gabion are filled by sand and then the cage becomes a firmly consolidated part of the shore. When Tsunami hits the Gabion it

absorbs sufficient amount of energy and the subsequent flow the height is considerably reduced.

An example from Teethal, District Valsad in Gujarat would illustrate the use of Gabions. This temple on the shore of Teethal was facing the problem of coastal erosion and the temple was threatened due to this. Suitable placing of Gabions near the Temple has provided very useful protective measures. After some time grass and other vegetation grows on the consolidated Gabions and the tsunami measures are fortified. The temple and the Gabions are shown in Fig. G 2

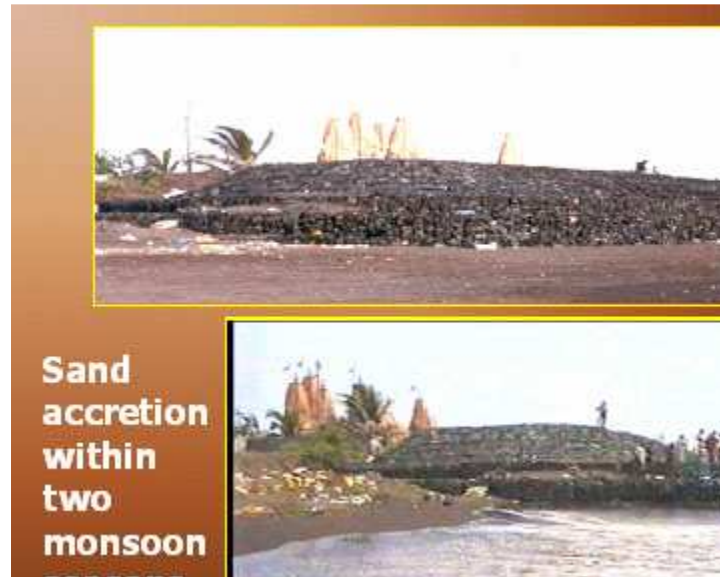


Fig. G 2 Gabions at Teethal Temple in Valsad District, Gujarat. Upper photo shows the general view of the Gabions and the lower photo shows the Temple and the Gabions at site.

**Recommendation: At suitable locations along the Kanyakumari coast the use Gabions would be useful in mitigating the Tsunami disaster.**



Photo 1. Shows the tsunami mark on the coconut tree and metallic part on the electric lamppost, which have been corroded. The points have been marked in red. This gives a clear idea of Tsunami height.



Photo 2. The lady in the picture Muttama was stuck up at the top of this tree during tsunami. On left is Tad Murty and on Right is Arun Bapat



Photo 3. Selvaraj was stuck up at the tree where he is standing.



Photo 4. The repairs on first floor indicate damage during tsunami and the level of Tsunami height.