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Original Research Paper

A Study on the Coastal Protection System Against Erosion of Bay of Bengal in North Chennai Coast, Tamil Nadu

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ABSTRACT

Equilibrium conditions at shores of Chennai were upset when an artificial harbour was constructed in 1875, which was projected about 1 km into the sea. Because of this construction, there is heavy accretion on the southern side of the harbour resulting in Marina beach and severe erosion on the northern side. The study of north Chennai coastal area involves the collection of bathymetry of the area, and data on waves, tides, currents and winds. After analysing the data, suitable remedial measures like construction of sea wall, groynes and break water were examined. Out of all, the function of sea wall was observed to be the best remedial measure in controlling the erosion. The data on physical model study available at Institute of Hydraulic and Hydrology, Poondi were examined and a suitable remedy was designed.

INTRODUCTION

India has a coastline of 7561 km of which Tamilnadu has 960 km. Out of this 900 km is along the Bay of Bengal in the east coast and 60 km along the Arabian sea in the west coast. This coastline forms roughly 1/6 part of the total Indian coastline. The coastline of Tamilnadu is of considerable economic and geographical significance. There are two major ports, one at Chennai and the other at Tuticorin with several minor ports and fishing harbours at different places. The equilibrium along Chennai coast was upset due to construction of an artificial harbour in 1875. There was no erosion problem so long as no structure was interfered with wind forces (National Coastal Protection Project 2002).

PRESENT STATUS OF ANTI SEA EROSION WORKS

The Govt. of Tamilnadu has been resorting to anti sea erosion measures in Tamilnadu for the past one decade. There are 46 rivers which flow into the sea along the Bay of Bengal in Tamilnadu. However, with the irrigation potential of these rivers fully exploited, the discharge from these rivers along the coast is very limited. The Bay of Bengal coast is much prone to cyclones than the Arabian sea and available data indicate that cyclones are 5 times more frequent in the Bay of Bengal than in the Arabian sea. The cyclones along the eastern coast have substantially more destructive potential than the Arabian sea cyclones (Oza & Oza 1998). There have been more than 32 disastrous cyclones since 1900. Annually, around three cyclones affect the Tamilnadu coastline. The tidal waves, heavy rainfall and winds that accompany the cyclones intensify coastal erosion.

Human intervention has also contributed to coastal erosion. The best example is the north Chennai coast. The serious problem of coastal erosion in Tamilnadu has attracted the Govt. attention from the early 1950 onwards. Since then the State has been implementing various protection works to suit the individuals site conditions in the coastal districts of Tamilnadu.

Table 1: Natural and anthropogenic causes of coastal erosion.

S.No.	Nature	Anthropogenic
1	Rise in sea level.	Construction of dams, dukes and other coastal structures.
2	Protruding head lands, reefs on rocks into the sea.	Groyens, break waters, jetties etc.
3	Tidal entrances and river mouths. causing interruptions of free passage of sediments along the sea shore.	Anthropogenic entrances causing interruptions of littoral drift.
4	Removal of beach material by wind drift.	Removal of material from beaches for construction and other purposes.
5	Removal of beach material by sudden outbursts of floored waters.	Digging of new inlets, channels and enhances offshore.

STORM WAVE ATTACK ON BEACH AND DUNE

Fig.1: Picture showing the sea wall construction.

During storms, strong winds generate high, steep waves. In addition, these waves often create a storm surge, which raises the water level and exposes to wave attack higher points of the beach not ordinarily vulnerable to waves. The storm surge allows the larger waves to pass over the offshore information without breaking. When the waves finally break, the remaining width of surf zone is not sufficient to dissipate the energy contained in the storm waves. The remaining energy is spent in the erosion of the beach berm and sometimes dunes, which are now exposed to wave attack by virtue of the storm surge. The eroded material is carried offshore in large quantities where it is deposited on the near shore bottom to form an offshore bar (Sunder & Angremond 2001).

CAUSES FOR COASTAL EROSION

Steep storm waves accompanied by strong shore winds are destructive on the shore. Coastal erosion is caused by the forces of nature and sometimes enhanced by anthropogenic structures (Garg 2002). From Table 1, it can be inferred that the causes are heading to natural and anthropogenic erosion.

COASTAL EROSION PROTECTION WORKS

Fig. 2: Picture showing the armour layer of the sea wall.

The requirement of a beach erosion control and shore protection study must be made from investigations of the past history from all available records and a study of the present conditions by means of level surveys and observations. Technical data developed in a beach erosion study should provide a clear definition of the problem. The types of shore protection measures are mainly sea wall, bulk heads, revetments, groyens, jetties, offshore break water and artificial beach nourishment.

The construction of sea wall, the armour layer of the sea wall and the sea erosion remedy wall are shown in Figs. 1, 2 and 3.

Table 2: Percentage frequency of occurrence of wave heights and wave periods of Chennai during north-east monsoon, non-monsoon and south-west monsoon.

Wave height groups in m	Wave period groups in sec					Total
	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	
North-east monsoon						
0.4 - 0.6	0.11	10.13	13.29	8.06	0.22	31.81
0.6 - 0.8	0.44	9.91	8.39	1.74	-	20.48
0.8 - 1.0	-	6.54	7.08	0.33	-	13.95
1.0 - 1.2	0.98	14.38	6.75	1.09	-	23.20
1.2 - 1.4	0.65	3.38	1.53	-	-	5.56
1.4 - 1.6	0.65	2.61	0.65	0.11	-	4.02
1.6 - 1.8	0.22	-	0.22	-	-	0.44
1.8 - 2.0	-	-	-	-	-	-
2.0 - 2.2	-	0.33	0.21	-	-	0.54
Total	3.05	47.28	38.12	11.33	0.22	100.00
	6 - 8	8 - 10	10 - 12	12 - 14	14 - 16	Total
Non-monsoon period						
0.4 - 0.6	1.78	13.15	14.37	1.78	0.09	31.17
0.6 - 0.8	1.50	12.68	7.89	0.28	-	22.35
0.8 - 1.0	0.56	5.63	3.19	0.19	-	9.57
1.0 - 1.2	3.10	12.30	6.10	0.85	-	22.35
1.2 - 1.4	1.69	3.00	2.25	0.28	-	7.22
1.4 - 1.6	2.07	3.47	0.47	-	-	6.01
1.6 - 1.8	0.28	-	-	-	-	0.28
1.8 - 2.0	0.38	0.09	0.21	-	-	0.68
2.0 - 2.2	-	0.28	0.09	-	-	0.37
Total	11.36	50.6	34.57	3.38	0.09	100.00
	4 - 6	6 - 8	8 - 10	10 - 12	12 - 14	Total
South west monsoon						
0.4 - 0.6	-	0.15	3.80	10.38	1.17	15.50
0.6 - 0.8	-	0.44	6.43	7.31	0.59	14.77
0.8 - 1.0	-	-	4.82	1.46	0.51	6.79
1.0 - 1.2	-	3.8	15.35	4.09	0.59	23.83
1.2 - 1.4	-	2.34	4.68	4.09	-	11.11
1.4 - 1.6	-	4.97	9.94	2.05	0.15	17.11
1.6 - 1.8	-	1.32	1.61	1.02	-	3.95
1.8 - 2.0	-	0.59	0.88	1.46	0.15	3.08
2.0 - 2.2	0.29	1.02	1.02	0.44	-	2.77
2.2 - 2.4	0.15	0.15	-	-	-	0.30
2.4 - 2.6	-	0.59	0.59	-	-	1.18
Total	0.44	15.37	49.12	32.30	2.80	100.00

COASTAL EROSION PROBLEMS

On the east coast of India, the net sediment transport along the shore towards north is about 1 million per year. The harbours along this coast are artificial ones formed typically by a pair of breakwaters. In order to intercept the transport of sediments, the break water on the southern side is larger than that on northern side, i.e., Chennai, Vishakhapatnam.

The impact of the construction of the coastal structures on shore line changes is studied by considering the effect of the construction of break water of the port in Chennai. The initial construction of Chennai port commenced in 1875 and has undergone several changes mainly to counteract the adverse problems associated with these sediments finding their way into the entrance channel. A sand screen on the southern side has been provided in order to arrest the movement and depression of sediments in the entrance channel. This could solve the problem only temporarily since after the advancement of the shoreline. Sediments entering into the entrance channel are presently being periodically dredged in order to maintain the sufficient draft for the sea going vessels.

THE POSITIVE ASPECTS OF THE CONSTRUCTION OF PORT

1. Formation of harbour for berthing vessels
2. Revenue of the port
3. Formation of the Marina beach which is claimed to be the second largest in the world

ANALYSIS

The analysis was done seasonwise, i.e., north-east monsoon (October-December), south-west monsoon (June-September) and non-monsoon (January-May). The two seasons to be considered as summer and winter. The variation of wave heights is quite complex and does not allow any standard distribution. The wave heights range from 0.4-2.4 m. The data considering both, wave height and wave period, for different seasons are presented in Table 2. It is seen that the wave heights are mostly less than 1.2 m to the extent of about 80% for the annual, 89% during south-west monsoon, 60 % during north-east monsoon and 85% during non-monsoon seasons.

THEORETICAL DESIGN OF SEA WALL

The design consists of the following stages:

1. Selection of design wave
2. Design wave height selected for designing sea wall
3. Crest elevation
4. Design of armour layer
5. Design of core layer
6. Design of filter layer

Fig. 3: Picture showing sea erosion remedy wall.

CONCLUSIONS

The study with the available data indicates that the area had undergone severe erosion and unless it is stopped, it will affect the industrial belt of north Chennai. Hence, the system of remedial measures by using rubble mound sea wall is suggested.

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