

Tidal Flow Characteristics at Kasheli (Kalwa/Bassein Creek), Bombay

G NARAYANA SWAMY & A SURYANARAYANA

National Institute of Oceanography, Dona Paula, Goa 403 004

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Tidal flow characteristics of waters at Kasheli, connected to the sea through Thane and Bassein creeks in Bombay are investigated based on tide and current observations carried out in 1980-81. The results establish that the tidal water enters the channel first through Bassein Creek rather than from Thane side. The currents are strong, ($1 \text{ m} \cdot \text{sec}^{-1}$) and are tidal, while during SW monsoon considerable flow towards the Bassein side is noticed. However there is indication that the flood tide water at Kasheli partly escapes into Thane Creek.

A project for laying treated water conduit from Bhatsai reservoir, crossing the Bassein Creek/Ulhas River at Kalwa near the existing Kasheli bridge, north of Thane has been undertaken by the Bombay Municipal Corporation (Fig.1). In Order to choose whether the pipeline should be laid over the creek bed or through an undercreek tunnel, extensive hydrographic studies have been carried out¹. This paper presents the tidal flow characteristics of this channel, based on observations on tides and currents.

Methods

The channel at Kasheli is connected to the sea off Bombay through Bassein and Thane creeks (Fig.1). However, navigation to the site is normally possible only from the Bassein side. Measurements were made during the onset of SW-monsoon (June), towards the end of monsoon (September), and during post-monsoon period (January), in 1980-81. Tidal heights were read against a graduated staff fixed at a convenient spot in the proposed site at Kasheli in May-June 1980. The water level variation was noted every 30 min for about 15 d continuously. The zero of the tide pole was levelled against the local bench mark, and all the readings were reduced to Town Hall Datum (Bombay). Current speed and direction were measured using NIO-made rotor current meter at 3 locations (A, B and C) along the proposed route of the conduit. Drogues were released at different spots in the creek and the trajectories mapped.

Results and Discussion

The tidal curve is presented in Fig. 2 along with the predicted tide² at Apollo Bunder (Bombay Harbour). The tidal characteristics at Kasheli were compared with the tidal information obtained earlier³ at Bassein and Thane. The time difference of high water and low water at Kasheli, Bassein and Thane with reference to tides at Apollo Bunder are shown in Table 1. The bathymetry of the channel as reported¹ in 1980, is

given in Fig. 3. The nature of the currents is summarised in Table 2. Fig. 4 describes the advection of the surface waters.

The tide at Bassein lags behind that at Apollo Bunder whereas the tides at Bassein and Kasheli lead over the tide at Thane (Table 1). The high tide at Kasheli lags behind the Bassein tide and leads over Thane tide by more than 30 min. The tidal water thus enters Kasheli first through Bassein Creek, rather than from Thane Creek. The float trajectories also confirm this (Fig.4).

The average tide at Kasheli is about 2.9 m (range 1.9-3.85 m). The average flood and ebb period is about 6 h. Compared with the average tide of 2.5 m at Bombay coast having spring tide of about 3.6 m and neap of about 1.4 m, the tide amplitude at Kasheli is seen to be

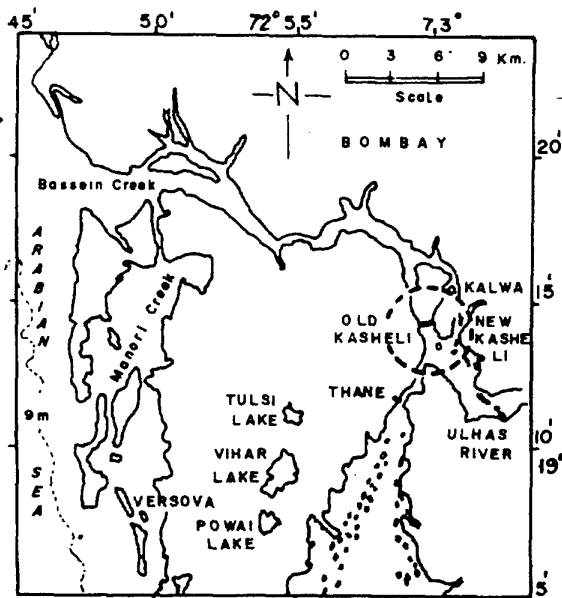


Fig. 1—Location map (Area of study is circled)

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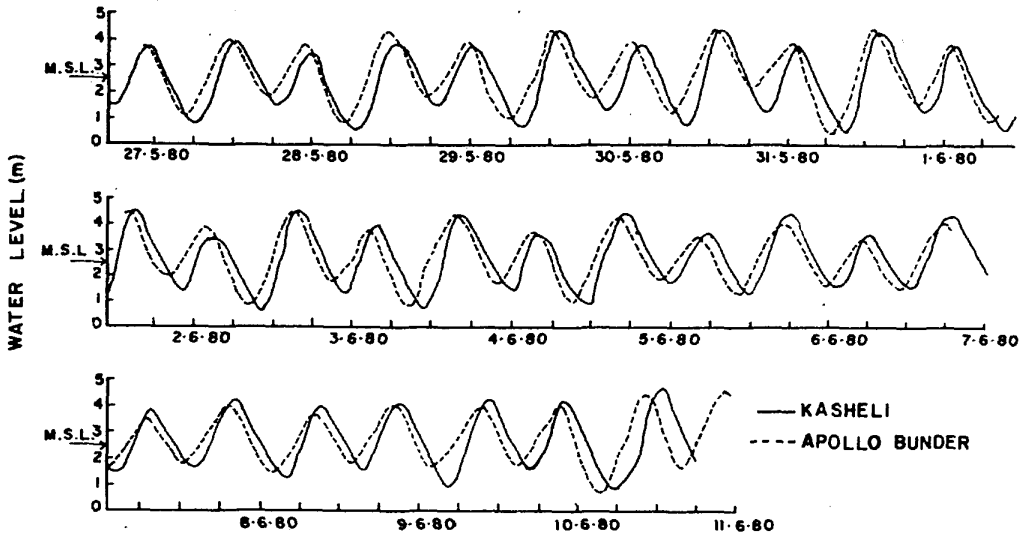


Fig. 2—Tides at Kasheli and Bombay Harbour (Apollo Bunder)

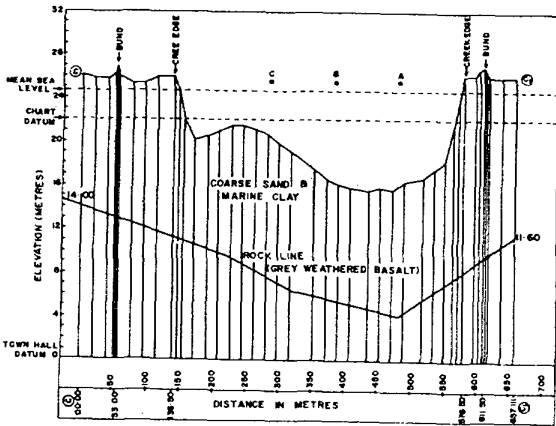


Fig. 3—Cross-section of the Kalwa/Bassein Creek at Kasheli (A, B and C, current observation stations)

Table 1—Tides at Kasheli, Bassein and Thane

Station	Time difference* (min)	
	High water	Low water
Kasheli	(+) 82	(+) 144
Bassein**	(+) 30	(+) 58
Thane**	(+) 130	—

*W.r.t. Apollo Bunder (Bombay Harbour)

**Admiralty tide tables³

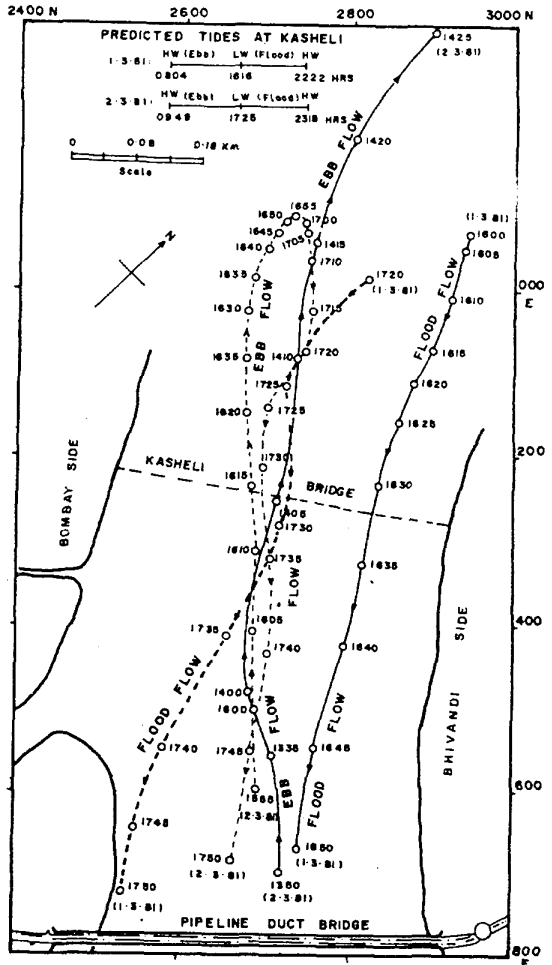


Fig. 4—Float trajectories at Kasheli (Numbers along the curves indicate time in hours on the dates shown)

slightly amplified. Convergence of tidal water as the creek shallowed and narrowed towards the head can cause such amplification⁴.

The results of current studies show that the currents at Kasheli are largely influenced by the tides and that the speeds are considerable during most part of the tidal march (Fig.4 and Table 2). The seasonal changes are also significant (Table 2). Vertical variation of the current velocity is marginal. During the peak monsoon months predominant flow is towards Bassein Creek with fresh water entering the channel at Kasheli from Ulhas River on the Thane side.

Occasional interchange of waters between Thane Creek/Bombay Harbour and Ulhas River/Bassein

Creek has been suggested in an earlier study⁵. Present estimates based on depth and spatial averages of flood and ebb velocities, and the cross-sectional areas during the high and low tides, indicate that on an average the tide-water flux during the ebb ($16 \times 10^3 \text{ m}^3$), is considerably less than that during the flood ($26 \times 10^3 \text{ m}^3$). While the tidal water enters Kasheli through Bassein Creek during flood and flows back during ebb, there thus appears to have a net loss of water towards Thane Creek. This is also reflected in the flood averages of the longitudinal current components exceeding the ebb averages for the same cycles of flood and ebb close to spring tides (Table 3). This is possible since Thane Creek is partially separated from Bassein

Table 2—Currents during Different Seasons
[Values are in $\text{m}\cdot\text{sec}^{-1}$]

Level*	St A				St B				St C			
	Spring		Neap		Spring		Neap		Spring		Neap	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Pre-monsoon												
S	—	—	—	—	1.45	0.07	—	—	—	—	—	—
M	—	—	—	—	1.14	0.06	—	—	—	—	—	—
B	—	—	—	—	1.34	0.05	—	—	—	—	—	—
Monsoon												
S	1.26	0.67	1.18	0.35	—	—	1.43	0.17	0.95	0.29	—	—
M	1.20	0.74	1.18	0.36	—	—	1.48	0.11	0.92	0.33	—	—
B	0.91	0.27	1.11	0.22	—	—	1.47	0.05	0.91	0.15	—	—
Post-monsoon												
S	0.77	0.18	0.95	0.14	1.23	0.18	1.10	0.05	0.45	0.05	0.53	0.09
M	0.73	0.11	0.97	0.12	1.13	0.11	1.00	0.13	—	—	—	—
B	0.63	0.14	0.63	0.21	1.09	0.14	0.74	0.08	0.37	0.10	0.54	0.10

*S = surface; M = mid-depth; B = near bottom

Table 3—Flood and Ebb Averages of Longitudinal Currents ($\text{m}\cdot\text{sec}^{-1}$)

Date	St	Tidal Phase*	Flood average			Ebb average		
			Surface	Mid-depth	Bottom	Surface	Mid-depth	Bottom
10.6.80	B	N-S	0.42	0.39	0.42	0.26	0.24	0.22
20.8.80	B	N	0.22	—	—	0.18	—	0.20
2/3.9.80	B	N	0.26	0.31	0.11	0.15	0.22	0.06
4/5.9.80	A	N	—	—	—	0.46	0.46	0.44
12.9.80	B	S	—	—	—	0.42	0.50	0.45
12/13.9.80	C	S-N	0.35	0.26	0.23	0.29	0.53	0.20
13.9.80	B	N	0.34	0.32	0.28	0.22	0.26	0.25
3.1.81	B	N-S	0.73	0.55	0.43	0.25	0.26	0.23
6.1.81	A	N-S	0.35	0.22	0.20	0.25	0.26	0.18
7.1.81	C	N-S	0.15	—	0.18	0.14	—	0.21
12.1.81	B	S-N	0.89	0.92	0.60	0.75	0.84	0.65
14.1.81	A	N	0.28	0.31	0.35	0.27	0.25	0.20
15.1.81	C	N	—	—	—	0.10	—	0.18

*S = Spring; N = Neap

Creek by a constriction and probably by a sill-like formation in between them (Fig.1). That part of the flood water that escapes to Thane Creek is no more available during the ebbing phase of the tide resulting in a lower low water owing to the residual loss. This may be a reason why the low-water level at Kasheli is observed to be almost always lower than that at Bombay Harbour, though the high-water levels are nearly similar during spring tides (Fig.2). Occasionally during neap, when the net loss to Thane Creek is minimal, the high-water level is higher and the low-water level not markedly affected.

It may be pertinent to point out that sometimes the current directions at st B show deviation from the pattern of flow at sts A and C. This may be due to the influence of the bottom topography and cross currents, added to the proximity of the stations to the pillars of Kasheli bridge. An extensive survey across the transect with closely spaced stations would reveal the small scale but interesting lateral distribution of current velocity in this channel.

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