AGENDA FOR URBAN CONCERN

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Making Karnaphuli effective

The search goes on

ARCHITECT DR NIZAMUDDIN AHMED

ONE may easily and perhaps out of ignorance quite innocently pop up the question: what is an architect doing in the middle of a river? Are not matters of training, dredging and river navigation the domain of the engineer?

The architect as part of his professional commitment fulfils his responsibility to the public by getting involved in environmental issues that affect the society. The architect does not merely serve his immediate client, which is his function at micro level, but has to take into account the public who may or may not be affected by his decisions as a given project is implemented.

Whereas River Karnafuli is not designated as an architectural commission, at least not yet, the creative mind understands that his city needs to be enriched and vitalized by each and every natural constituent, performing at their possible best, in order for his profession to make any worthwhile contribution for the general public.

In his search for relevant materials related to River Karnafuli as part of Forum for Planned Chittagong's (FPC) commitment to bring to focus the issue of its conservation, essential as the city's lifeline, Architect Q S Tauheed delves into reports of eminent British engineers and offices, much of which has now gained historical importance alongside their technical magnitude.

Part 1 of his paper appeared on this page a fortnight back on 1 July. In Part 2 he deals with the concept and importance of a single channel, the training and dredging works necessary to stabilize and maintain a navigable channel, the estuarine limits, and the works undertaken in the lower and the upper estuaries.

Let the systematic methodology adopted by FPC be a directive for other development concerns in the country so that issues are also considered in the context of history and mistakes not repeated; decisions not given at the spur-of-the-moment by non-professional bureaucrats and politicians.

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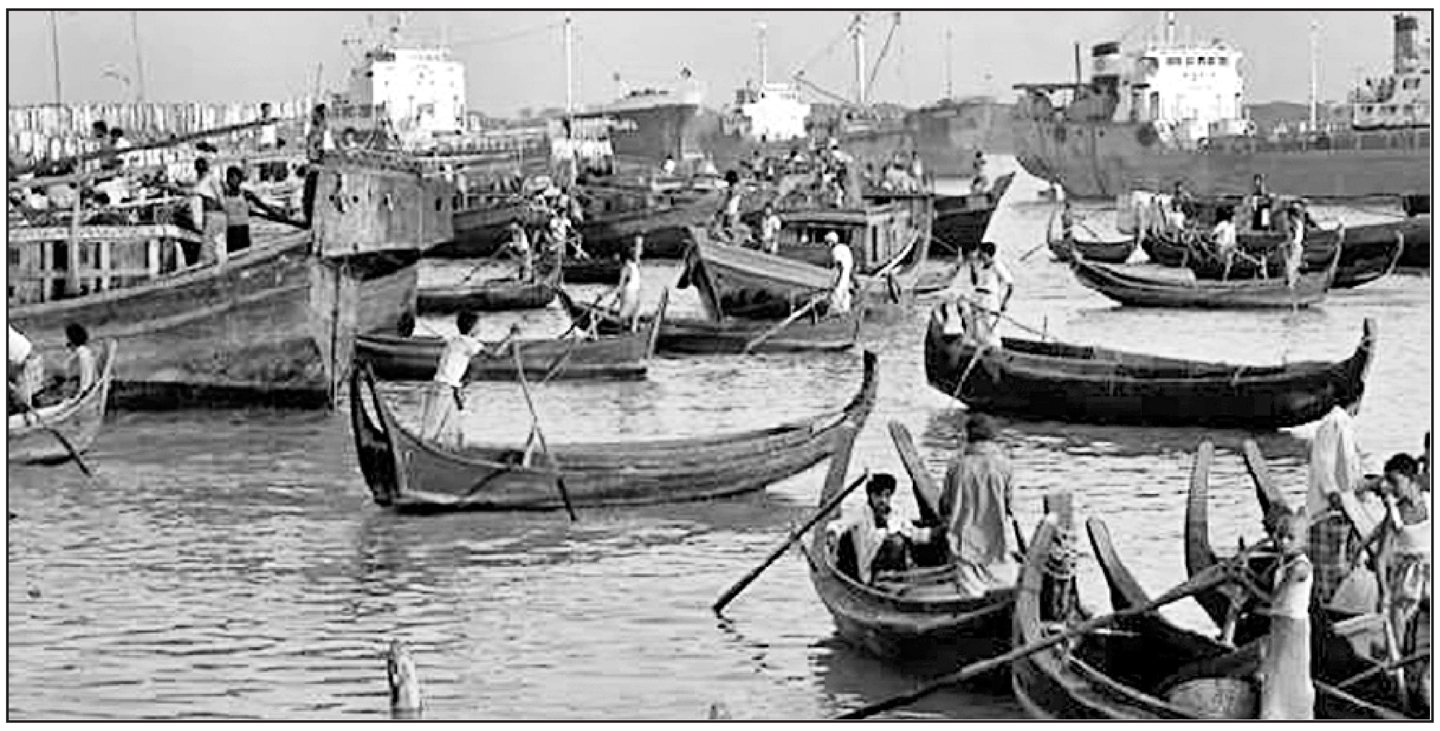

Karnafuli river

Forum for planned Chittagong's search for its conservation - II

(Part 1 appeared on this page on 1 July)

ARCHITECT Q S TAUHEED

Single channel: Concept and importance

Experts have opined to maintain the flow of the river in a single channel, the banks 1900 feet apart, starting at the railway bridge and extending as far downstream as Sadarghat with gradual expansion in the lower limit up to its mouth.

The reasons to train such a flow is based on Claude Inglish's Report "Before considering why changes have taken place in the Karnafuli in the past, it is important to realize that these changes result from the interactions of several complex variables; so that one factor much as the straightening effects of bridge piers on flow, an important long-term factor, may for a short time be completely masked by a temporarily dominant short-term factor like curvature of flow, which in turn has resulted from other variables. It is therefore rarely justifiable to say a particular change has been due to a particular factor. It is also important to remember, that although the changes resulting from erosion and accretion mainly occur during ebb flow, it is the increased or decreased penetration of flood tides that determines whether or not an estuary improves or deteriorates. For this reason the improvement of flood tide flow is all-important and should be kept constantly in mind.

Claude Inglish has frequently commented upon the desirability of training rivers so that the flood and ebb tides follow the same course. Where this is not the case, the flood tide penetration is reduced due to the flow being tortuous and split into two or more channels, with shoals and chars impeding flow. For this reason it is important to train the flow into a single, very gradually expanding, or uniform channel."

It stands clear then that the river should be effectively trained to stabilize a single channel so as to accommodate navigation for ocean-going and inland vessels during ebb and flood tides. The efforts that were made by the engineers 1894-1939 to prevent instability within the tidal length of port limit are examples of maintaining a single channel. Though these recommendations were not based on detailed investigations or model study, but they bear the success of exemplary engineering feats, accomplished by virtue of background and experience. The works that were carried out during 1905 to 1945 cover almost 8.5 miles of revetments in the lower and one mile in the upper estuary.

Claude Inglish conducted detailed investigation 1948-1960 and dedicated a decade to investigate and propose remedial measures to improve the conditions of the Karnafuli. An eminent engineer, Inglish was director of Hydraulic Research Station, Wallingford, Berkshire, England under the Department of Scientific and Industrial Research, UK. Under his direction the first physical model covering the entire tidal length of the river was reproduced in a scale of 1/500 horizontally and 1/60 vertically, in two stages. The Stage I model covering the tidal length of 16 miles, starting some 10 miles upstream of the jetties down to Gupta crossing some 4 miles from the mouth was completed in 1956. The stage II model was joined to the first in 1960 after the prototype data required within the offshore area were made available. In his recommendations Inglish proposed that the 1900 feet spacing of the banks were desirable "not merely to stabilize flow, but also to make it possible to reclaim and develop large areas of land". Later studies 1960-2002 recommended revetment works in the existing erosion prone zones and other specified areas of the banks, and to carry out capital and maintenance dredging to ensure that the navigable channel throughout the tidal length is effectively established restricting further movement.

Training and dredging works to stabilize and maintain the navigable channel

Estuarine limits: This report is mainly concerned about conservation and maintenance of the estuarine limits of the port. The upper limit falls into the Halda, about 1¾miles from Kalurghat Bridge, some 10 miles upstream; whilst the lower limit is some 10 miles downstream of the jetties, where the flow falls into the sea by the bell mouth entry. This limit is extended by an area covering 5½ nautical miles radii into the sea. Besides, the land limits extend 150 feet on either side of the bank line. Therefore, the conservation and maintenance of the estuary and its adjoining banks falls within the legislative limits of the port.

Training and dredging works in the lower estuary: All the training works carried out by the Port Commission prior to inviting experts in 1948 are based on the Admiralty Charts from 1840 to 1901 for the lower estuary, followed in 1917 by a chart extending up to Kalurghat in the upper estuary. These charts were fortunately available and are particularly interesting because they record the natural development of the river in its untrained state and illustrate the river's violent changes that took place during the latter half of the 19th century.

The strengthening of the natural stability of the old port from Sadarghat to Double Mooring and its extension by revetment involved throwing boulders from ships which is understood to be the first training work undertaken without expert opinion. J. A. ApJhon, chief engineer and vice chairman of Calcutta Port in 1893 and 1900 recommended that the river from Double Mooring to Gupta point (some 4 miles apart) should be effectively revetted, and although costly it was absolutely necessary. He was of the opinion that besides pitching the right bank the consequent improvement over the outer and inner bars was not possible only by a combination of dredging and training. He further proposed to regularize the width of the main channel by training the Juldia and Patenga arms, constructed by silts, pumped up by "Lindon Bates" dredger and kept in place by piles. The above proposals led to difference of opinion between ApJhon and J. R. Bell, the consultant to the port. During his visit to Chittagong 1904, Bell came to the conclusion that training along the right bank has to be done gradually at 2000 feet per year, whilst the dredging operations should be carried out after observing its consequent effects at the bars because he believed that the situation over the bars mainly depends on revetment works up to Kumar Khal. Bell and Railway's consultant Alexander came to the conclusion that the training of the river along the Juldia and Patenga arms, as proposed by ApJhon, will be costly and its results unpredictable, because interference with nature at one point may be followed by unexpected fatal results at other.

The proposals of Bell and Alexander were accepted by the commissioners and the revetment work of 4000 feet from Double Mooring down to Kumar Khal was started and continued up to Gupta point in phases between 1905 and 1912. The decision to implement the work in phases was mainly because of two reasons, firstly, to observe the after effects of the training works, specially the conditions over the outer and inner bars and secondly, the availability of stones transported by Assam Bengal Railway from Jettinga, some 270 miles away. On the basis of above decision, the port commission ordered for a dredger from Scotland in 1905, which was later assembled in Calcutta and sailed to Chittagong in 1907. This was the first dredger for Chittagong Port and was named as Karnafuli-I.

The dredging work started in April 1907 and continued for 14 years except in 1910-11 when the dredger was sent to Calcutta for maintenance. The total volume of dredged materials removed during the period was 114 million cubic feet incurring an expenditure of Rs. 12lac and Annas 15. Interestingly the dredger Karnafuli, procured for specified dredging works, was used by the commissioners for all purpose. Bell and Gibson (Commander, Royal Indian Marine), technical and administrative in-charge of the dredger respectively billed the dredger as "our maid of all works" and recommended that it should be employed fulltime for the purpose for which it was brought.

The frequent channel movements caused due to erosion and corresponding accretion within the tidal length of the river was a fundamental concern of the port commissioners who were responsible for maintenance and development of Chittagong Port. This concern made them focus their attention towards establishing a judicious approach, to search for remedial measures and to carry out the works as directed by the engineers of the port. Efforts were made to stabilize the flow conditions under the prevalent circumstances.

Bell carried out a reconnaissance survey and estimated that about 250-300cft per running feet, equalling 30 lac cft (approximately) of stone were dropped from ships for two miles for bank protection from Sadarghat to Double Mooring. From the above estimate it is projected that almost 13.5 million cft of stone were transported by wagons from Jettinga to pitch 8.5 miles of banks in the lower limits from 1904 to 1945. The problems the commissioners had to face while implementing the above works were the scarcity and delayed mobilization of requisite quantity of stone within the desired time, effects of flood, the World War II and availability of fund, delaying the progress of the works substantially. Despite the constraints the work was completed as designed, reflecting well on the determination and commitment of the port administration.

The most prominent characteristic of channel movement observed within the lower estuary between 1901 and 1930 is the migration of the Patenga Channel apart from the Juldia Channel by 1500 feet by 1917 and 1000 feet by 1930 in a North-Westerly direction, accompanied by subsequent increase in the area of Middle Island and consequent sharpening of the Gupta Bend. With a view to check further aggression and to protect further sharpening of the Gupta Bend, it was decided that the right bank of the channel should be effectively pitched without delay. As a result the construction work of the two-mile long embankment was started in 1930 and completed in 1932. The upper arm, 8400 feet of it, is called the Patenga Revetment whilst the lower arm extending 3200 feet into the sea is called the Patenga Foreshore Training Wall. The immediate action to pitch the Patenga arm was taken for two reasons, firstly it would protect further movement of Patenga arm west ward and secondly it would stop the possibilities of sharpening of the reverse bend (Gupta Bend). If the initial movement of the Patenga arm could have been protected by 1917 and later by 1930 the consequent sharpening of the reverse bend could have been checked but unfortunately this could not be achieved because the port commission had to concentrate more on the revetment works foreshore of Chittagong with the quantity of stones that they could mobilize. But after the above work was completed they were able to start the revetment work of Patenga arm by 1930. Under the present situation the radii for outer, centre and inner curves are approximately 4400, 3800 and 2000 feet respectively, much below the preferable 9800 to14700 feet. Today the maximum permissible length of ships allowed to pass through this bend is 575 feet (175 meters).

After successful completion of Patenga revetments it was then decided to close the Juldia Channel. The construction work of the1500-feet crescent-shaped embankment was started in 1932. The objective was to protect the upstream nose of the middle island shoal and restrict flow through the Juldia Channel. This formed the head of Juldia Training Wall. The revetment work is approximately parallel to and 2400 feet apart from the tip of Patenga revetment. Revetments of 3000 feet and 2500 feet were added to the crescent head in 1935 and by 1937 respectively, and by 1939 the work of another 1000 feet was constructed to achieve a total length of 8000 feet. The work was kept suspended to observe the effects of flood and also to observe the after effects of training works. After the freshets of 1942, another 3500 feet was added to the previous works and completed to its final length of 15000 feet in the following dry season. Later it was shortened by 2850 feet so that both the walls end opposite each other. This was adopted as standard for all future experiments.

The inherited Patenga Foreshore Training Wall and the Juldia Training Wall, still sighted from the beach limits of Patenga, are living history of relentless works that were carried out 70 years back with the objective to stabilize the flow through a single channel and to maintain the navigable depths for the vessels calling to the port for over a century. Trade through water ways are comparatively economic and can be sailed in bulks. It is a resourceful means of transport. Therefore important water ways are to be effectively maintained for rapid growth of trade as is in the case of Chittagong Port.

Training and dredging works in the upper estuary: Although flow conditions and navigable depths in the lower estuary are being periodically maintained, it is also important that the upper estuary should be equally conserved because the conditions of the river upstream have consequent effects downstream. Experts had expressed concern on the unstable conditions of the river at Nazir Char and Bakalia Char that determines the condition downstream within the reaches, and also the conditions similar in nature over outer and inner bars while erosions were taking place foreshore of Chittagong. Therefore it is important to search for the training and dredging works that were carried out and those recommended but could not be implemented within the upper limits of the Karnafuli system.

In 1939, F. J. Green, the port engineer, submitted a scheme for the upper river, that included the revetment works at Bakalia, training wall along the left bank at Kolagaon and the construction of Chittagong Training wall along the right bank between Sadarghat to Chaktai. These schemes were not approved. Instead in 1941 a skeleton scheme that included the construction work of upper part of the Chittagong Training Wall, known as the Upper Training Spur and the Bakalia revetment was approved. After construction of 1600 feet of the Upper Training Spur and part of the Bakalia revetment the work was suspended because of World War II. During the floods of 1942 and 1943 all the works of Bakalia and 450 feet of the Upper Training Spur were washed away. After the floods of 1945 the extension of Upper Training Spur was completed to its final length of 3000 feet.

The above works were considered important because the commission wanted to regulate the river width as far above the jetties as possible and thus preventing the formation of shoals in mid-stream which might subsequently work down into the jetty reaches. It was in the midst of such unstable conditions, when the Port Commission had decided to seek expert opinion. As a result Claude Inglish was called in 1948, "to consider the changes which have taken place in the river since 1917, and in light of those changes and in consultation with the port engineer Green, to put up proposals as to the most suitable river course to develop and the measures which should be taken to attain that object."

During the period 1954-60 the works as proposed by Inglish and subsequently implemented are the closure of Balur Channel, (West of Nazir Char) by a T-shaped embankment, removal of the Ring Bar by dredging as it was responsible for poor depths at the jetties, dismantling of Upper Training Spur; modification to the river entrance training works dredging on the Outer-Bars, cessation of spoil dumping in the river opposite to the jetties and repositioning of the offshore dumping site. All the above works that were carried out showed a favourable effect within the jetty reaches.

Recommended training and dredging works in the upper estuary: The future works recommended by Hydraulic Research Station, England in order of urgency are: (a) Closure of the Karnafuli by-channel to help increase tidal penetration up the Karnafuli and stabilize conditions in the lower river. The model results showed that almost 47% of the flood tide flows through the mouth of the confluence i.e. between right bank and Halda Char, of which 29 % enters the Halda river while the rest 18% flows through the by-channel into the Karnafuli main. In order to control flow at 71% through the Karnafuli and 29% through the Halda, the by-channel should be closed. (b) Closure of upper and lower end of Balur Channel. As mentioned earlier, although Balur Channel had silted up considerably since its closure in 1956, it is still open at both ends. This invites instability of flow and is liable to initiate meander. Therefore it was recommended that both the upper and lower end of Balur Channel should be effectively closed. (c) Filling of the embayment upstream of the jetties on suggested alignments.

Claude Inglish therefore emphatically stated that unless the works (a) and (b) are carried out in the near future a cycle of deterioration must be anticipated, which may be impossible to reverse for several years. These works, though partly implemented, had not been effectively accomplished for reasons unknown, and may be responsible for the present deteriorating conditions as anticipated by Inglish.

Since the opening of the Bakalia left channel in 1954 and its subsequent enlargement the main channel between Kalurghat and Bakalia Char had been moving laterally. By 1955 the Balur Channel decayed and the central channel East of Nazir Char, accommodated large portion of the total flow, subsequently eroding the upper end of the Bakalia Char with corresponding accretion at its tail and consequently moving the shoal ¾ miles downstream. Bakalia Char was then acting as an island control, bifurcating the main flows in both the channels. From the model study it was found that the discharge was more through the left than the right. But because the conditions downstream of the shoal seemed to be nicely balanced, it was not clear how the river would alter between Bakalia and Sadarghat during the next few years. Therefore the question of closing either of the channels was suspended until conditions were favourable.

The concluding part 3 of this report shall be published in a fortnight.

The author has his own practice in Chittagong and is General Secretary Forum for Planned Chittagong