AN ALTERNATIVE PROPOSAL FOR JETTY AND PONTOON DESIGN IN PATURIA FERRY GHAT

S M Ikhtiar Mahmud¹, Dishan Majumder², and Shahriar Hasan Fahim³

Department of Naval Architecture and Marine Engineering, Military Institute of Science and Technology, Mirpur Cantonment, Dhaka, Bangladesh
¹E-mail: smikhtiar@gmail.com
²E-mail: dishan60@gmail.com
³E-mail: fahimfahim590@gmail.com

ABSTRACT

The Paturia ferry terminal in Manikganj is the most important for road connectivity with the entire country. The ferry ghats of Patria and Daulatdia are located on the Padma River's left and right banks, respectively. Both ghats connect the districts of Manikganj and Rajbari to the continuation of road transport. Paturia ferry terminal is one of the major ferry routes connecting southern Bangladesh to the rest of the country. It also connects neighboring India by transporting passenger buses and freight trucks from one river bank to another. The ghats of the Daulatdia and Paturia ferries have been threatened by a recent significant erosion of the Padma River's banks. Since 2015, the disintegration has been ongoing. Flash floods, turbulence, and strong currents in the Padma River eroded a large area, including the ferry wharf and river banks, and the river vanished. During the rainy season, the water level has become elevated because the ghat is flooded and needs to move to continue the operation. The present traffic system cannot cope with an enormous load of vehicles. The primary goal of this research was to develop a long-term solution that could withstand seasonal water level change. In the proposed plan, it is included five terminals, three terminals for utility ferry service, one for passenger vessels and the remaining one for speedboat mooring terminal. It is also generated pontoon design for its adjacent ghats, which was evaluated from an existing Sadarghat terminal and collected from BIWTA. This design includes 2D and 3D views animated using AutoCAD and SolidWorks.

Key words: Ferry terminal, water level, bank erosion, jetty and pontoon.

1. INTRODUCTION

The Paturia-Daulatdia Ferry route is located over the Padma River, just downstream of the confluence of the Jamuna and the Ganges River. Administratively, Paturia and Daulatdia ghats are situated at Manikganj and Rajbari District respectively. Width of the Padma River along the route is around 3 km [1]. Due to bank erosion of Padma River and mismanagement of traffic system this ghat is threatened. The entire layout must be altered in consideration of the impending issues in order to restore the ghat's stability. In order to efficiently complete the project's design and development, references that pertain to the project were sorted. The operational aspects, testing aspects, and design aspects are a few of those. Samiul Alim presented an effective waterway design for calculating dredging costs and expenses (oil cost, crew salary, maintenance cost) that can generate a healthy revenue for the government in his paper [2]. CEGIS detailed the hydro-morphological study of the Paturia-Daulatdia ferry ghats, as well as the layout plan and design of the ferry ghats and terminal building [1]. Arifur Rahman presented seasonal variations in the physicochemical and biological aspects of the Padma River at Paturia Ghat in his paper [3]. Yousuf Gazi's paper described an assessment of morpho dynamics using geospatial techniques at the confluences of the Padma and Meghna rivers in Bangladesh [4]. Uma Saha described the soil liquefaction of Afsarsheikher Para in her paper, which is one of the vulnerable bank sides of the Padma River adjacent to Daulatdia ferry ghat of Goalanda upazilla in Rajbari district [5]. In his research paper, Thor Erik Sandberg Hanssen develops a model to investigate how various factors affect ferry riders' terminal wait times [6]. The data are based on
interviews with 10,952 Norwegian ferry passengers who boarded the ships shortly before the interviews. Icho Seimokomoh Igwe has presented a pontoon and scantling design based on the worst design pressure condition [7], which is for the maximum submersion draft. All scantlings designed, including corrosion allowance requirements, conform to DNVGL-RU-FD Table 3. The hydrodynamic properties of a pair of long floating pontoon breakwaters with rectangular sections are investigated theoretically by A.N. Williams [8].

2. DESIGN PLAN

2.1 Initial Findings

The upper portion of the Padma River are the main concern for achieving the goal of this research. Preparation of the layout plan and 3D view and animation of ferry ghats at Paturia and Daulatdia in the Paturia-Daulatdia navigation route requires confirmation of the site, the topography of the site and traffic data for the ferry ghats. The following Figure 1 was taken from Paturia terminal during the physical survey.

Figure 1. Paturia Ferry terminal.

Three ghat based on water level is designed to withstand the present condition in the proposed solution. This assumption is considered via taking water level data from Baruria transit (near the Paturia ghat) shown in Figure 2.

Figure 2. Baruria transit [1].

The trend of the maximum water level has been slightly increasing over the years. The maximum water level wavers between 7.8 to 9.8 mPWD [1]. The maximum water level was measured as 9.88 mPWD in 2004 and the lowest at 1.31 mPWD in 2006. Even though BIWTA is maintaining the Paturia-Daulatdia ferry route in Padma River and the related ferry points at its two ends, the riverbank area suffers from bank erosion continuously.

Figure 3. Water level at Baruria transit [1].

2.2 General Layout

The design plan should work for ferries, passenger ships, and speedboats all at the same time. The entire ferry ghat is connected to a critical roadway from Dhaka to Paturia. To reach the ferry ghat, vehicles will
take the main route, and then split for the terminal. For varying water levels, each terminal has three subdivision roads. The pontoon will be adjusted to accommodate seasonal water levels. Tugboats or land-based system will be used to complete this task. The main road, connected to the highway, descends a slope to the river. The present research is more of macro-level planning, for this reason many finer points could not be shown in the layout drawings. The site layout plans are prepared considering general and specific requirements related to each site. Particular attention has been given to planning their placement to ensure smooth berthing and maneuvering. Daily and seasonal Water Level (WL) fluctuations have been considered in preparing the ghats. High water, mid water, and low water ghats have been provided. Measurement of area carried out by considering following factors shown in figure 4.

i. Existing situation  
ii. Seasonal water level  
iii. Highway-river bank land height deviation  
iv. River bed condition  
v. Traffic situation

2.3 Ferry Terminal

In the proposed plan, terminal-2 to terminal-4 is for ferry transportation shown in figure 5. To solve the Paturia ghat area problem, it is installed 3 subdivision road for each terminal. These three roads are for different seasonal water level. Each subdivision road has distance of 17.50 m. Each terminal contains three roads for high water level, mid water level and low water level. In the design,

• High water road is 6m extended from the shoreline.  
• Mid water road is 9m extended from the shoreline.  
• Low water road is 12m extended from the shoreline.

2.4 Ferry Terminal Pontoon

The floating pontoon will rise and fall with the seasonal water level. During normal, disturbed, and emergency incident settings, pontoons must be built to allow for safe and orderly passenger movement. The following pontoon design was evaluated from an existing pontoon at Paturia Ghat shown in figure 6. The goal of this design is to handle both Ro-Ro and conventional utility ferries. Three ferries can berth at once on the pontoon. In total, nine ferries can run simultaneously in three terminals. The design was created using the Solidworks design module, and the 2-D projection was created using AutoCAD.

2.5 Passenger Vessel Terminal

In the design plan the terminal-1 is for passenger ship transportation shown in figure 7. This route has a considerable number of passenger vessels. In addition, compared to other Ferry ghats, the passenger load is substantially higher. Physical survey is used to construct the design. A standard passenger station has passenger stalls as well as an office room with a ticket counter, public washroom, and other administrative functions.

2.6 Passenger Vessel Terminal Pontoon

The pontoon is designed for passenger vessels shown in figure 8. Physical survey is used to acquire
design data from existing pontoons in Shadarghat, Dhaka. The pontoon has six office rooms, including a washroom, an office, and a waiting room. A shedding is placed in the pontoon to provide rain and sun protection for the passengers. The pontoon is equipped with mooring bollards. Fore protection, a railing is attached to the backside of the pontoon. To avoid colliding with the vessel, fender is installed.

2.7 Speedboat Terminal

The distance between Paturia and Daulatdia is 3 kilometers. In reality, residents from the southern part of the state use this route for emergency transportation. People cross the river in speedboats or engine boats to avoid the heavy traffic. Furthermore, when compared to other routes, the passenger load is significantly larger. So, in the design plan terminal-5 is for speedboat, engine boat transportation shown in figure 9.

2.8 Speedboat Terminal Pontoon

A special pontoon with staircase system included in the speedboat terminal shown in figure 10. Data is for this pontoon also collected from Shoarighat, Dhaka by physical survey from existing pontoons. The stair system is built into the pontoon for easy passenger movement. This stair system allows passenger access 0.80 m below the pontoon surface. The pontoon design includes a total of five staircases.

3. RESULT AND DISCUSSION

The existing ferry ghat is more conventionally designed. The main road diverged toward the pontoon via a fixed road. The main problem in Paturia ghat is that the water level goes up and down with the seasons. Based on the information presented above, we have developed the following pontoon shifting procedure for Paturia Ghat. Table 1 lists the dimensions of the pontoons and the terminals that are adjacent to them.
Table 2. adjacent pontoon dimension

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Ferry terminal pontoon</th>
<th>Passenger vessel terminal pontoon</th>
<th>Speedboat terminal pontoon</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>main pontoon</td>
<td>extended office room(2x)</td>
<td></td>
</tr>
<tr>
<td>Length [m]</td>
<td>30</td>
<td>08</td>
<td>30.50</td>
</tr>
<tr>
<td>Width [m]</td>
<td>12</td>
<td>05</td>
<td>7.60</td>
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<tr>
<td>Depth [m]</td>
<td>02</td>
<td>02</td>
<td>02</td>
</tr>
<tr>
<td>Draft [m]</td>
<td>01</td>
<td>01</td>
<td>01</td>
</tr>
</tbody>
</table>

3.1 High Water Phase

The proposed model high water ghat will be constructed at 10 m PWD. When the high-water level arrives, the pontoon will be shifted to the high-water ghats (C1, C2, C3) shown in figure 11. In the meantime, other ghats will go underwater will be unable to operate. The assumption is to run in this ghat when the water level rises above 7.5 m PWD.

Figure 11. High water phase

3.2 Mid Water Phase

Mid water ghat will be constructed at 7 m PWD. When water level goes below high-water level, the pontoon will be shifted at mid-water ghats (B1, B2, B3) shown in figure 12. In the meantime, low water ghat will be stayed underwater, and high water ghat will be way above the water and unable to operate. The assumption is to operate in this ghat when water stays between 4.5 to 7.5 m PWD.

Figure 12. Mid water phase

3.3 Low Water Phase

Low water ghat will be constructed at 4 m PWD to operate in the low water phase. When the low water level arrives, the pontoon will be shifted at this ghats (A1, A2, A3) shown in figure 13. In the meantime, gangway that is hinged to the road. The gangway’s opposite end will be at the pontoon, serving as a bridge connecting the terminal and the pontoon. When the water level is low, it can create a lower slope; when the water level is high, it can create a raised slope. The pontoon will be supported by two spud pillars attached to the pontoon’s backside. These spud pillars ensure that platforms float securely on the water and do not drift away from the work area. Aside from the spud pillar, rope system will also be installed to ensure the safe positioning of the pontoon shown in figure 13.

Figure 13. Spud pillar system
3.4 Traffic Survey

Even after the opening of the Padma Bridge, it has been noted that users in the Faridpur, Rajbari, Magura, Jhenaidah, Kushtia, and Chuadanga districts still favor the ferry services between Paturia and Daulatdia. The Bangladesh Inland Water Transport Corporation (BIWTC) figures also showed a decrease in the number of vehicles crossing the Padma through Paturia, with an average of 3,600 different vehicles crossing the river every day from June 20 to June 24. Even after the Padma bridge was inaugurated, 2,600 vehicles passed through on June 26 and 27. Buses, cargo trucks, private cars, and motorcycles are examples of vehicles.

4. CONCLUSION

To overcome the current situation at Paturia ghat, a ghat area layout has been designed to cope with seasonal water levels. For each terminal, three subdivision lanes were designed. This road leads to different water level ghat. This design contains a specialized pontoon for the ferry, passenger vessel, and engine boats. These designs were created throughout physical survey in Shadarghat, Shoarighat and Paturia. Pontoons will be installed in the terminal. Newly built Padma Bridge is a great challenge for the existence of ferry service in the routes between Paturia and Daulatdia. The ferry services between Paturia and Daulatdia based on the efficient and reduced transportation time will help to exist these services. It is expected that even existing of the Padma Bridge, the importance of the ferry services between Paturia and Daulatdia may remain priority choice of the users in Faridpur, Rajbari, Magura, Jhenaidah, Kushtia, and Chuadanga district.

5. REFERENCES


