JOURNAL OF MARITIME RESEARCH

Vol XX. No. III (2023) pp 88–93

ISSN: 1697-4840, www.jmr.unican.es

Conceptual Design and Economic Analysis of a floating stadium for indoor games in the capital city of Bangladesh

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ARTICLE INFO

Article history:
Received 21 May 2023;
in revised from 28 Jun 2023;
accepted 01 Sep 2023.

Keywords:
Dhaka city, playground, conceptual design, floating stadium, economic analysis, viable solution.

ABSTRACT

The overpopulated city of Dhaka faces a severe shortage of open fields and playgrounds with a deficit of 152.80 acres. To address this problem, an alternative solution in the form of an Indoor Floating Stadium has been conceptualized. The stadium will be built on available calm water such as Hatirjheel, Dhanmondi Lake, Purbachal Ecopark lake, Nikunja Lake, Ramna Lake, Diabari Lake, and Chandrima Udyan, providing an open space for children and adults alike. It is expected to serve as a versatile venue for a variety of sports events and practice sessions for neighborhood or school-based sports teams. The stadium has the potential to inspire and educate the younger generation while connecting people from diverse backgrounds and ethnicities through the power of sports. The economic viability of the indoor stadium has been also analyzed, and it has been concluded that it is a viable solution for the city.

1. Introduction.

Youths are the foundational stones and the future of a country. Young generations are anticipated to be lively, with vibrant looks. This generation will be the country's and the world's future leaders. Dhaka has a very large population of around 22.5 million people. Almost half of these people are young, with around 9-10 million of them being youth. Young people used to wrestle as a form of entertainment in the past. This eventually became a popular social activity in which people would assemble in specific unoccupied spaces or sports grounds and engage in fun physical activities. This is a significant cultural trend that provides numerous benefits to people's physical, mental, and social well-being. Furthermore, young people are encouraged to be creative and think outside the box.

However, in recent years young people in Dhaka have faced a variety of physical, mental, and social issues due to a lack of playgrounds and physical activities. This has resulted in a decrease in their overall well-being, making it difficult for them to perform to their full potential. To cope with their depression and a lack of outlets for physical activity, many of them turn to drugs and illegal activities. (Whitebread, 2017). Most first-world countries like Japan, United States, United Kingdom, Canada, and Australia have an adequate amount of green space per person and have enough parks and playgrounds for children. Unfortunately, Bangladesh, India, and Pakistan do not have enough playgrounds for their children and security concerns make it difficult for children to visit the few that do exist (S.P. Dewi,2012). The Dhaka Metropolitan Development Plan (DMDP) reported that Dhaka City had 0.5 square meters of green space per capital in 1995. Now, Dhaka has only 0.052 square meters of green space per person, which is a concern for the population's physical and mental well-being, particularly for the youth, who have few options for outdoor play (WBB Trust,2015).

In another context, Dhaka has several notable lakes in strategic locations which are near residential and commercial areas, schools, and universities. The beneficial wetlands of Dhaka City have approximately 30-35 khals or natural drainage, totalling nearly 437 km^2 and including four major rivers: the Buriganga River, the Turag River, the Balu River, and the Tongi River (Marju Ben Sayed,2017).

Under this Circumstances, this study proposes an alterna-

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tive solution to Dhaka's playground shortage. The proposal is to construct a Floating Indoor Stadium on available calm water such as Hatirjheel, Dhanmondi Lake, Purbachal Ecopark Lake, Nikunja Lake, Ramna Lake, Diabari Lake, Crescent Lake, and Chandrima Udyan rather than on land. This stadium can be used for various sporting events and team practices, as well as a place for children and adults to play and spend quality time. A floating stadium provides numerous benefits to athletes, youth, and the surrounding community.

2. Methodology.

Data were gathered in massive quantities by using a variety of methods, such as literature reviews, analyses of possible customers, and the selection of the most convenient places. Youths who are enrolled in school, college, or university are the target audience for data collecting. Additionally, different sports people are also asked to contribute to the survey. Surveys conducted through google forms and are regarded as primary data. Secondary information gathered from newspapers, journal and article reviews, and various literature reviews.

Primary data was analyzed and presented thorough charts, tables, diagrams, and other graphical methods. The optimum dimension was chosen after considering client demand and space availability in various lakes. The dimensions were chosen to accommodate other facilities as well as serving as a multipurpose indoor stadium. Additionally, design and construction should be done following client demand as figured out by surveys and international maritime standards.

Economic analysis of the project should afterwards be assessed after calculating the construction cost, operational cost, and other costs, as well as the revenue model. To calculate breakeven point the following formula is used.

$$\text{NPV} = 0$$

Where,

$$NPV = A \times \left(\frac{(1+i)^n - 1}{i \times (1+i)^n} \right) - P_0$$

A = Net income/year.
i = Discount rate.
P_0 = Initial Cost.

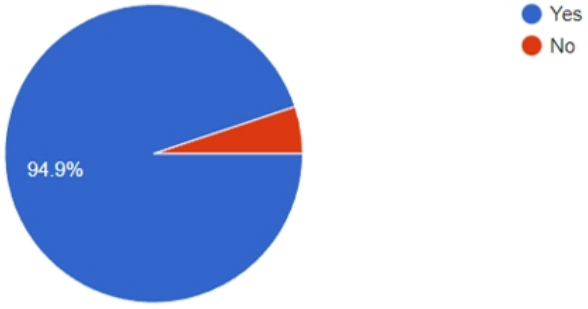
3. Result and Discussion.

This section focuses on the survey results obtained from the main stakeholders and customers. These results were used to develop drawings and conduct a cost analysis.

3.1. Survey Results.

People are asked questions to determine whether the market is ready to embrace the unique idea of a floating indoor stadium in the city of Dhaka. Most of the participating age group, which ranges from 21 to 25, has expressed interest in this initiative. The highest proportion comes from students and non-government employees. Almost people from all areas of Dhaka have participated in this survey and expressed interest, and 95% of people would be pleased to have this alternate solution to the playground crisis depicted in Figure 1.

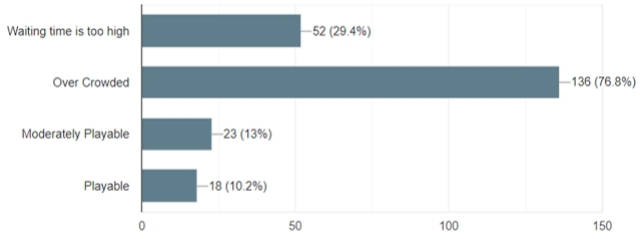
Figure 1: Interested in sports of the respondents.



Source: Authors.

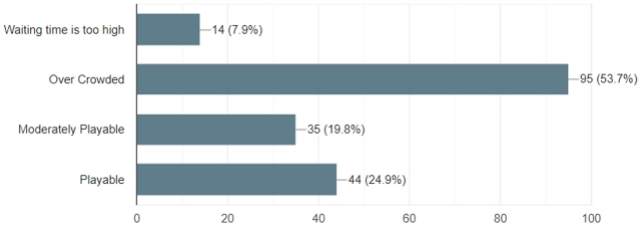
When stakeholders were questioned about the presence of playgrounds in the area, 40% of them said that there are no playgrounds at all. Respondents from the remaining 60% of the sample claimed that there was not much space for playing available. The following charts are a summary of the available playgrounds' condition.

Figure 2: Playground situation in holidays.



Source: Authors.

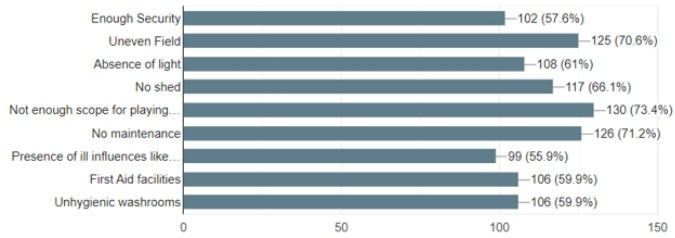
Figure 3: Playground situation in normal working days.



Source: Authors.

Figure 4 shows that a substantial number of respondents were unsatisfied with the current traditional playgrounds owing to a range of issues, including a lack of security, uneven field conditions, a lack of lighting, poor maintenance, a lack of first aid facilities, and unhygienic restrooms. In fact, more than half of the people surveyed expressed dissatisfaction with the playground's present state.

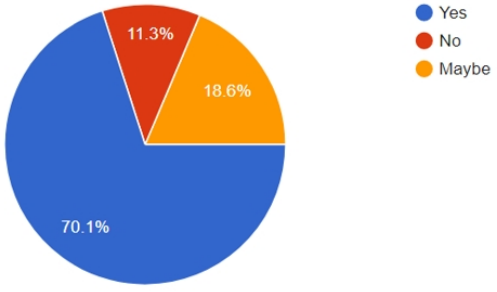
Figure 4: Scenario of visit to conventional existing playgrounds.



Source: Authors.

The people are then questioned on the acceptance of new ideas like a floating indoor stadium that would resolve all the playground-related issues**.** Figure 5 shows that almost 70% of respondents expressed interest in the floating indoor stadium.

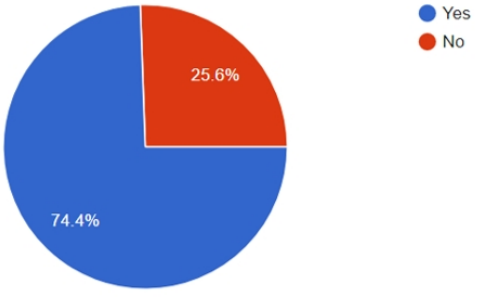
Figure 5: Opinion of the respondents about the floating stadium.



Source: Authors.

The willingness to pay is depicted in Figures. 6 and 7, and the preferred range is $5 to $20 per month. According to Figure 7, 57.1% of respondents are willing to pay between $5 and $10 to use the facilities.

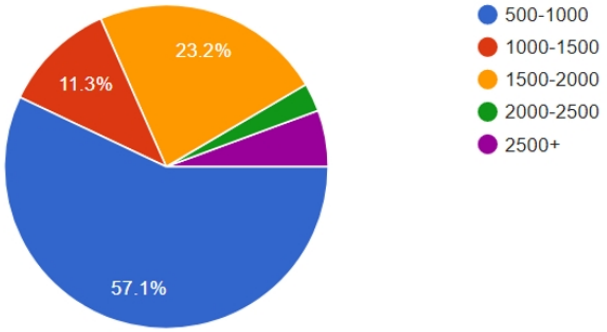
Figure 6: Willingness to pay.



Source: Authors.

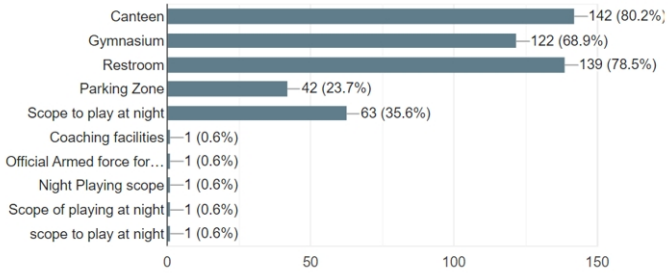
*Conversion Rate: 1 USD = 100 BDT.

Figure 7: Range of monthly payment (BDT).



Source: Authors.

Figure 8: Additional facilities requirements.



Source: Authors.

3.2. Selection of Location.

The current study took Tran's (My Tran, 2021) recommendations for consideration when deciding on a suitable location for the floating indoor stadium in Dhaka. Hatirjheel Lake, Gulshan Lake, Dhanmondi Lake, and Diabari in Uttara were identified. These locations were chosen because lakes are easily accessible, close to residential areas, and have good transportation options. Furthermore, the floating stadiums will not impede water transport in the lakes, and proper waste management can be implemented to minimize any negative environmental impact.

Figure 9: Location of Hatirjheel Lake.

Source: Authors.

Figure 10: Location of Gulshan Lake.

Source: Authors.

Figure 11: Location of Dhanmondi.

Source: Authors.

Figure 12: Location of Diabari Lake.

Source: Authors.

4. Design and Development.

The findings of the survey show that the targeted consumers are interested in a variety of sports and other amenities including gyms, medical centres, rest rooms, and restaurants. The actual construction of the indoor stadium that is well-equipped with the necessary amenities to satisfy the clients' requests represents the project's next big obstacle. In order to ensure safety, the floating stadium must also adhere to the International Maritime Organization's (IMO) stability criteria for stability and the environmental standards set by international classification societies. A preliminary General Arrangement (GA) Plan for the indoor stadium has been created with all of these considerations in mind. A draft General Arrangement (GA) Plan for the ship has been developed. Elevation, side view (gallery) and plan views of different deck have shown in Figure 12. 3D view of the floating indoor stadium has been also shown in Figure 13. The indoor stadiums' principal particulars are displayed in Table 1.

Table 1: Principal particulars of the Floating Indoor Stadium.

Item	Symbol	Value	Unit
Length Overall	L_{OA}	60.00	[meter]
Length Between Perpendiculars	L_{BP}	60.00	[meter]
Breadth Moulded	B_{MLD}	40.00	[meter]
Depth Moulded	D_{MLD}	2.50	[meter]
Draft Design	T	2.20	[meter]
Block Co-efficient	C_B	0.94	--

Source: Authors.

Table 2: Space available for different sports and activities.

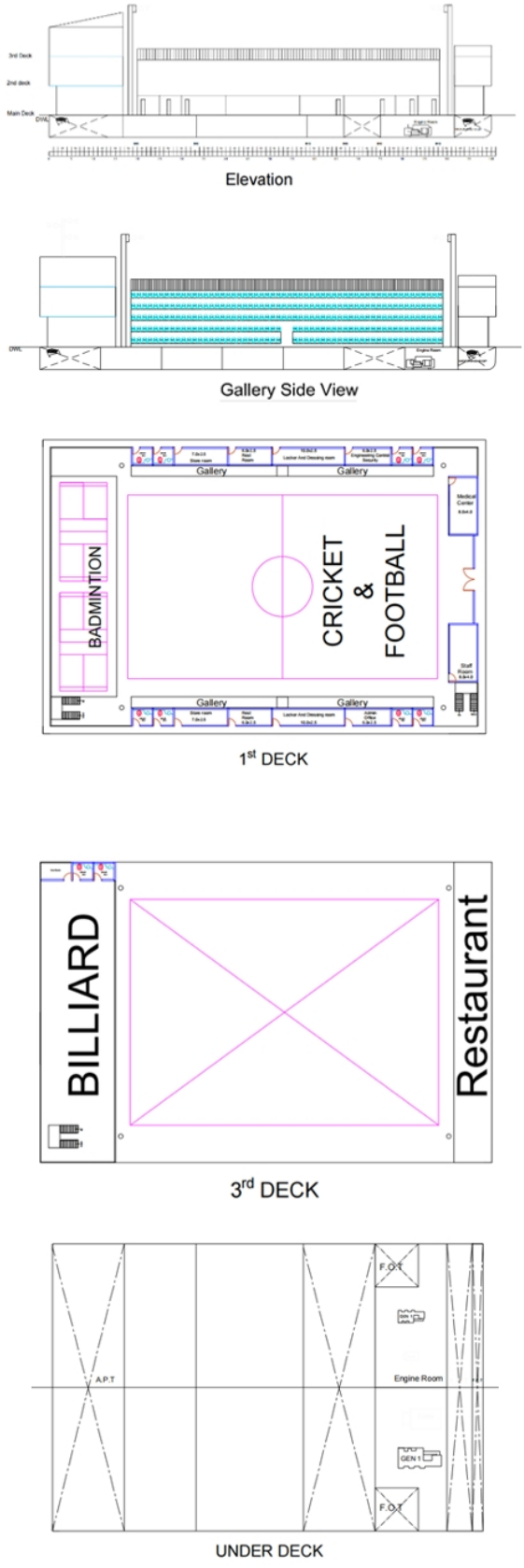
Sports/Activities	Length (Max) (m)	Width (Max) (m)
Football	42	25
Cricket	42	25
Billiard	32.5	10
Badminton	30	9
Kids Zone	35	5
Gymnasium	32.5	10

Source: Authors.

5. Economic Analysis.

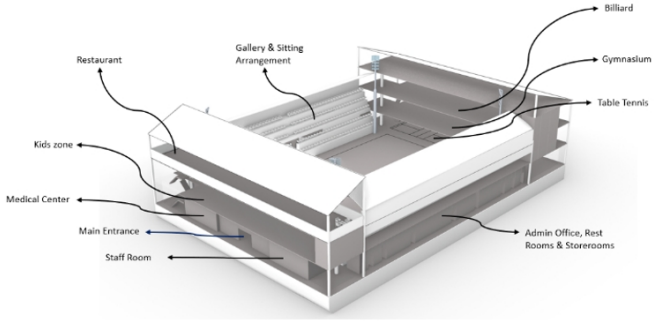
To determine the annual income, it is assumed that the entire floating indoor stadium is open for business 25 days out of every month, and that the capacity is utilized at 70% of its maximum level. The yearly cashflow is determined by taking the annual income as inflows and deducting the outflows, which consist of monthly wages, the bare minimum of operating expenses, and power bills. The summary of break-even calculation is shown in Table 3. It will take at least 6.83 years, assuming an 8% discount rate, to completely repay the initial construction cost. A detailed initial cost, revenue and expenses are given in appendix.

Figure 13: Preliminary General Arrangement Plan of the stadium.



Source: Authors.

Figure 14: 3D view of the Floating Indoor Stadium.



Source: Authors.

Table 3: Break-even point calculation.

Items	Amount
Initial construction cost	$1,425,927
Monthly operational cost	$5,780
Monthly revenue (70% utilization rate)	$29,020
Net income per year	$278,880
Breakeven point (8% discount rate)	6.83 Years

Source: Authors.

Conclusions.

For Bangladesh's capital city, the indoor floating stadium idea is unique and innovative. It will address real-world issues like the playground shortage in Dhaka and may offer a better setting for several athletic events and recreational amenities for residents of the capital city than the one now available. In addition, a comparable price with other indoor stadiums will give it a competitive advantage. Furthermore, it is clear from the economic study that the venture would reach full profitability after 6.83 years of operation if the entire business model and other problematic concerns are well managed. However, there are certain limitations on this study as well. The lack of reliable information about lakes, particularly the chosen places' depth and water quality are some important causes of limitations and if more people participated in the survey, then the findings would be more accurate.

Recommendations.

To get a clear idea of the practicability of this project a pilot project should be run. A thorough economic analysis should be conducted after obtaining the data from the pilot project.

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Appendix.

Table 4: Calculation of total power required.

Type of Room	No of Room	Power Needed/ROOM	Total
Washroom	14	762	10668 W
Restroom	4	230	920 W
Admin Office Room	1	5505	5505 W
Storeroom	2	230	460 W
Security ROOM	1	380	380 W
Locker and Security Room	2	455	910 W
Staff Room	1	380	380 W
Medical Center	1	5655	5655 W
Badminton Court	1	1260	1260 W
Cricket/Football Court	1	12240	12240 W
BILLIARD	1	11970	11970 W
Gymnasium (Dhaka Tribune,2019)	1	21970	21970 W
Kids Zone	1	11970	11970 W
Restaurant	1	6180	6180 W
Gallery	2	710	1420 W
Outside Light	1	600	600 W
Machinery Room	1	220	220 W
Pump	2	1500	3000 W
		Total	**96 KW**

Source: Authors.

To meet up the electrical power, it uses two Ricardo Canopy Diesel Generators, each with a 50 KW output, to provide the required power. The selected generators are in-built foreign canopy Ricardo Series units, with a rated prime power of 50kVA / 40kW.

Table 5: Initial Construction Cost calculation.

Item	Qty	Unit Price	Total Price
Hull Construction Materials			
Steel Cost	903	$950	$858,203
Piping and Valve (5%)			$34,328
Paint Cost			$68,656
Power System Cost			
Generator	2	$4,700	$9,400
Switch + Switch Board +Socket + Light + FAN			$9,790
Cables			$500
Anchoring			
Anchor	4	$250	$1,000
Winch+ Mooring Ropes	4	$500	$2,000
Navigational Light (For Night)	2	$100	$200
Pumps			
General Service Pump	1	$240	$240
Sanitary Pump	1	$80	$80
Door and Window			
Door	32	$100	$3,200
Window	18	$300	$5,400
Transparent Thai Glass	3	$20,000	$60,000
Fire Extinguisher	20	$50	$1,000
Gymnasium Equipment			$75,000
Billiard Coat			$2,000
Kids Zone's Equipment			$2,000
Cricket/Football Carpet	1	$2000	$2,000
Badminton Carpet	1	$2000	$500
Accommodation			
Spectators Chair	100	$25	$2500
Toilet Fittings	14	$300	$4,200
Officer/Staffs Room			$1,000
HULL FABRICATION & YARD COST + Electric COST			$325,640
Block Transportation			$30,000
Total Initial Cost (USD)			$1,425,928

Source: Authors.

Table 6: Estimation of Revenue.

Annual Income	
Gymnasium	
No. Of Accommodation in 1 shift	60
No of Shift	5
Fees per month per person	$20
Total Income	$6,000
Badminton (2 Coat)	
No. Of Accommodation in 1 shift	8
No of Shift (1 hours)	10
Fees per person per shift	$2
Total Income per month (25 Days)	$4,000
Billiard (Coat 10)	
No. Of Accommodation in 1 shift	20
No of Shift (1 hours)	10
Fees per person per shift	$1.5
Total Income per month (25 Days)	$7,500
Kids Zone	
No. Of Accommodation in 1 shift	30
No of Shift (1 hours)	10
Fees per person per shift	$2
Total Income per month (25 Days)	$15,000
Football/ Cricket	
No of Shift (1.5 hours)	8
Fees per shift (as group)	$40
Total Income per month (25 Days)	$8,000
Sponsorship and advertising	
Average monthly earnings from sponsorship	$208
Cafeteria	
Monthly rent	$750
Total Income per month (25 Days)	$750
Overall Monthly Income	$41,458
Overall Yearly	$495,000
at 70% Capacity Utilization Rate	
Overall Monthly Income	$29,020
Overall Yearly Income (USD)	**$3,465,000**

Source: Authors.