Extended Abstract | DOI: Not Included | Open Access

Geotechnical Feasibility of Building Foundations in Low-Clay, Braided River Levee Deposits in Jamalpur Science and Technology University Site: An SPT Study

Md. Junayed Jahangir[1*], Sadia Ferdows[1], Aronya Shihab Mahi[1], Waheda Akhter[1], Ishrat Jahan Eva[1] and Mrinal Kanti Roy Chowdhery[1]

[1]Jamalpur Science and Technology University, Melandaha Upazila, Jamalpur district, Bangladesh

(*Corresponding E-mail: junayedjahangir9@gmail.com)

Received: July 5, 2025, Accepted: August 21, 2025

Abstract: **Jamalpur Science and Technology University is located (24.9562° N, 89.8502° E) at Nayanagar Union in Melandaha upazila, Jamalpur district. According to geomorphological context, this university site is characterized as a natural levee within a braided river depositional setting of the Brahmaputra. The high-energy depositional conditions characteristic of braided fluvial systems is reflected in the subsurface strata, which are primarily composed of medium- to fine-grained sand with less than 10% clay content representing Holocene deposits. To evaluate the soil density and bearing capacity of the site for building foundations, Standard Penetration Test (SPT) N-values were acquired at 15 locations where the depth ranges from 1.5 ft, 3 ft, 4.5 ft, 6 ft, 7.5 ft, 9.0 ft, 10.5 ft, 12 ft, 13.5 ft, 15 ft, 16.5 ft, 18 ft, 19.5 ft, 21 ft, 22.5 ft, 24 ft, 25.5 ft, 27 ft, 28.5 ft, and 30 ft. Since disturbed soil was collected, the first 6'' (15 cm), which is the seating drive, had not been counted. The Standard Penetration Test (SPT) blow counts (N-values) range from an average of 7.66 at a depth of 1.5 ft (corresponding to the first 12 in. or 30 cm penetration) to an average of 48 at a depth of 30 ft, based on measurements from 15 test locations. The soil at shallow depths, when SPT N-values are less than 10, reflects recently deposited, weakly compacted facies and is characterized by loose sand or soft clay. From a geotechnical perspective, these materials are more prone to settling, have a low bearing capacity, and are very compressible. On the other hand, highly dense sand, gravel, or stiff clay, which reflect older, well-compacted river deposits, dominate the soil profile at deeper depths when N-values surpass 40. These deeper layers are appropriate for supporting engineering foundations because of their increased stability, reduced compressibility, and great bearing capacity. However, the site's vulnerability to liquefaction during seismic stress may be increased; the low clay content decreases plasticity and compressibility. Across 15 drilling locations, groundwater was found at an average depth of about 20 feet, suggesting a rather shallow water table state that is characteristic of natural levee deposits. In the sandy stratum, the groundwater table's location has a significant impact on soil strength, settlement patterns, and possible liquefaction susceptibility. Because of their low bearing capacity and significant danger of settlement, the loose upper layers are not appropriate for direct shallow foundations without modification. While deep foundations, such as driven piles or bored piles, that terminate in the dense sand layer at about 25 to 30 feet are advised for medium to heavy structures or where differential settlement and liquefaction are concerns, shallow foundations may be used for light, low-rise structures only after ground improvement (such as compaction or stone columns) to achieve adequate density. This will ensure stability, adequate bearing capacity, and long-term performance.**

Keywords: ***SPT, N-values, Borehole.***

Introduction

Jamalpur Science and Technology University is located (24.9562° N, 89.8502° E) at Nayanagar Union in Melandaha, Upazila, Jamalpur, District (Figure 1).

One of the biggest braided rivers in the world, the Jamuna River, has an active floodplain where Jamalpur is located. Young alluvial coarse sand (0.5 mm to 1 mm), silt, and clay make up the majority of the region, which is continuously altered by channel shifts, erosion, and sedimentation. Its geology is extremely dynamic and prone to erosion due to frequent floods, neo-tectonic activity, and human impact (Sarker et al., 2014). The standard penetration test (SPT) is defined as a method used to determine the standard penetration resistance of soil by driving a split-barrel sampler into the ground and recording the number of blows required to achieve a specified depth. The results depend on various factors, including drilling conditions and the energy delivered during the test (El-Reedy, 2017). Samples of disturbed soil are utilized for chemical and biological studies, but they lose their natural structure. When examining physical and technical qualities, undisturbed samples maintain their structure.

Methodology

Overview of site

The investigation was carried out on the Jamalpur of Science and Technology University campus. This site was chosen because expansion project is being done there and the purpose was to understand more about

the soil quality in the area. For soil testing and data collection, the site proved suitable.

Borehole investigation

Throughout the campus, 16 boreholes were drilled. Each borehole was sunk at a varied depth to examine the way the soil varies at depth. Soil samples were taken for observation from each layer.

SPT counting

At depths, Standard Penetration Tests (SPT) were carried out in every borehole. The seating drive is the initial 6 in of penetration sampler inti=o the soil. The number of hammer blows (N-value) was used for measuring the soil's strength or compactness.

Data analysis

After collecting all the field data, we looked at the SPT results and soil data to determine the nature and resilience of the soil. This helped us decide whether the soil was suitable for construction. Additionally, we collected several soil samples from different depths to conduct further laboratory studies.

Results and discussion

The general result of SPT-N value inspection around all boreholes available in Figure 2, 3 and 4 and indicates strong and denser soil layers increasing with depth is also in Table 1. Near the surface (1.5 ft to 15 ft) depth SPT N- value around 4 to 31, which indicates the soil is loose, while deeper (15 ft to 30 ft) SPT N-value is 31 to 50, which describe higher resistance and higher lode bearing capability. This will ensure stability, adequate bearing capacity, and long-term performance.

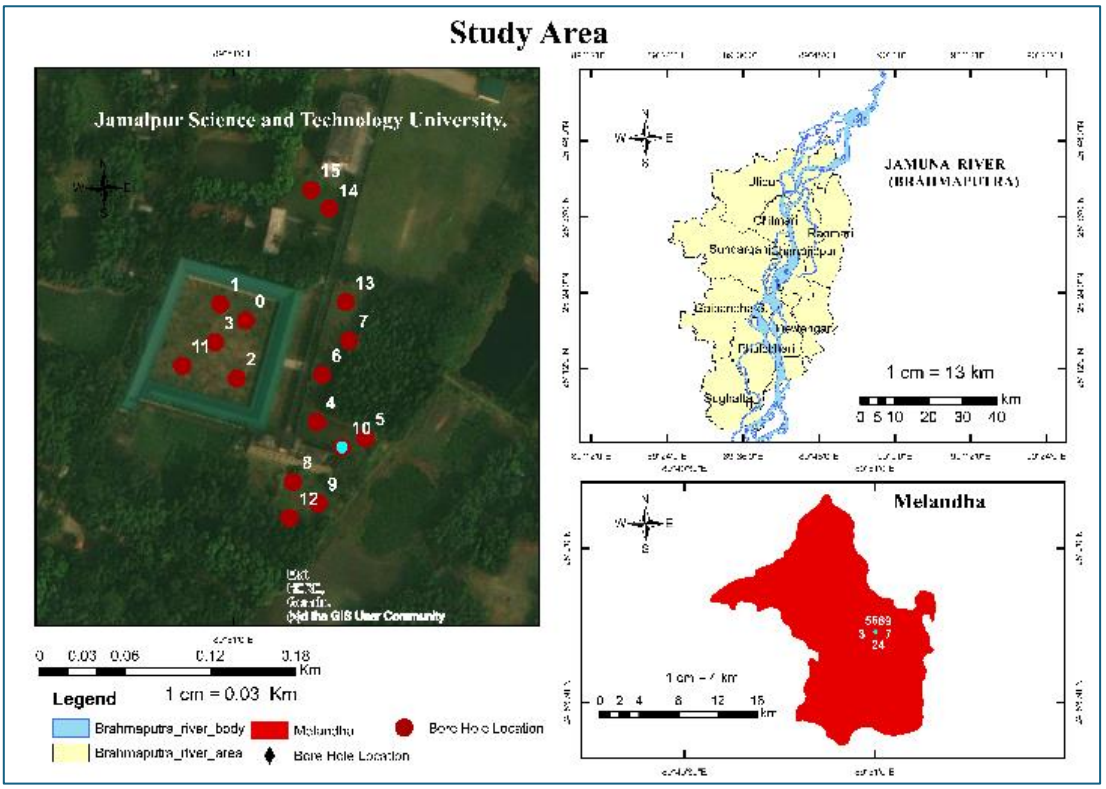

Figure 1, Location of the study area.

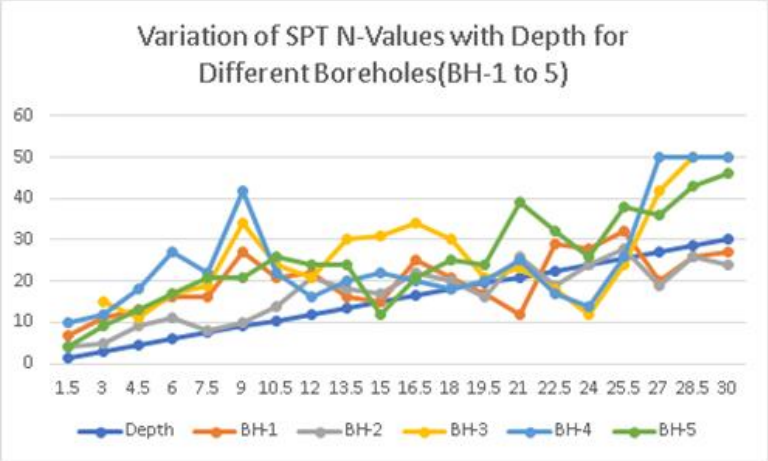

Figure 2, Variation of SPT N-value for BH-1 to 5.

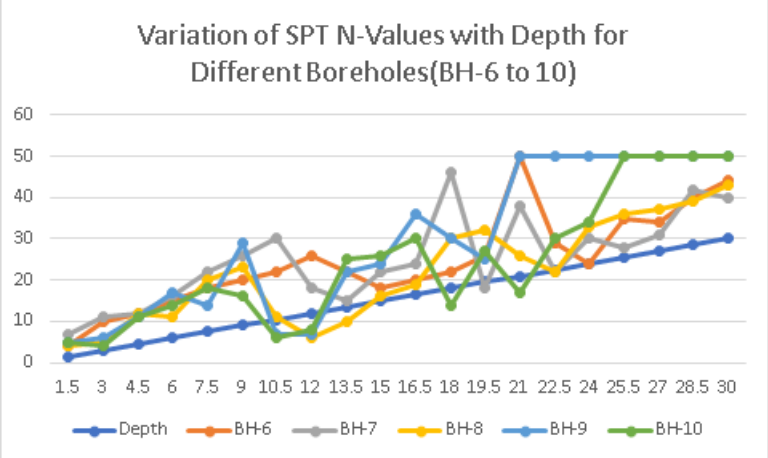

Figure 3, Variation of SPT N-value for BH-6 to 10.

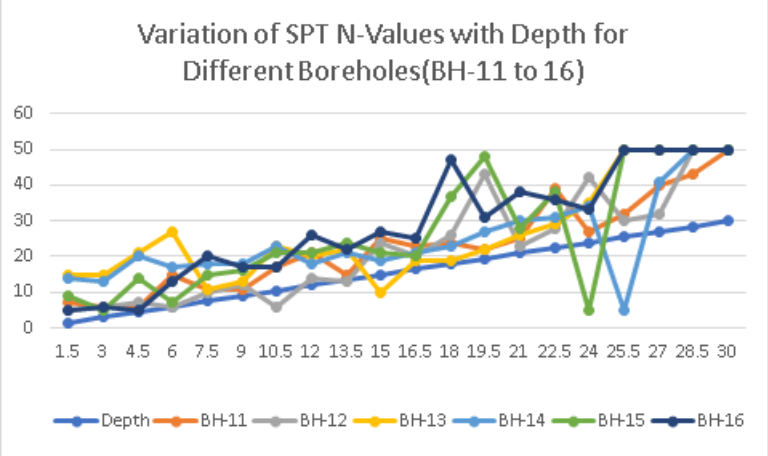

Figure 4, Variation of SPT N-value for BH-11 to 16.

Table 1, SPT N-value for all boreholes.

Depth	BH-1	BH-2	BH-3	BH-4	BH-5	BH-6	BH-7	BH-8	BH-9	BH-10	BH-11	BH-12	BH-13	BH-14	BH-15	BH-16
1.5	7	4		10	4	4	7	4	5	5	7	5	15	14	9	5
3	11	5	15	12	9	10	11	5	6	4	6	6	15	13	5	6
4.5	13	9	11	18	13	12	12	12	11	11	6	7	21	20	14	5
6	16	11	17	27	17	15	16	11	17	14	15	6	27	17	7	13
7.5	16	8	19	22	21	18	22	20	14	18	11	10	11	18	15	20
9	27	10	34	42	21	20	26	23	29	16	11	12	13	18	16	17

10.5	21	14	24	22	26	22	30	11	7	6	17	6	23	23	21	17
12	22	21	21	16	24	26	18	6	7	8	21	14	20	18	21	26
13.5	16	18	30	20	24	22	15	10	22	25	15	13	22	21	24	22
15	15	17	31	22	12	18	22	16	24	26	25	24	10	19	21	27
16.5	25	22	34	20	21	20	24	19	36	30	23	20	19	21	20	25
18	21	20	30	18	25	22	46	30	30	14	24	26	19	23	37	47
19.5	17	16	21	20	24	26	18	32	25	27	22	43	22	27	48	31
21	12	26	23	25	39	50	38	26	50	17	25	23	26	30	28	38
22.5	29	19	18	17	32	29	22	22	50	30	39	28	29	31	38	36
24	28	24	12	14	26	24	30	33	50	34	27	42	35	34	5	33
25.5	32	28	24	26	38	35	28	36	50	50	32	30	50	5	50	50
27	20	19	42	50	36	34	31	37	50	50	40	32	50	41	50	50
28.5	26	26	50	50	43	40	42	39	50	50	43	50	50	50	50	50
30	27	24	50	50	46	44	40	43	50	50	50	50	50	50	50	50

Conclusion

In conclusion, the geotechnical anatomy of Jamalpur Science and Technology University, STP N-value indicates soil strength increase with depth, reveals the soil loose to dense. The deeper N value shows greater load bearing capacity with high shear strength. For safe and durable foundation piling is required around 20 to 30 ft. The soil is suitable for light foundation without piling. Due to its low clay content the soil has minimal deformation. Overall, the soil is good Geomechanically.

Reference

Sarker, M. H., Thorne, C. R., Aktar, M. N., and Ferdous, M. R. (2014). Morpho-dynamics of the Brahmaputra–Jamuna River, Bangladesh. Geomorphology, 215, 45–59. https://doi.org/10.1016/j.geomorph.2013.07.025

El-Reedy, M. A. (2017). Soil investigation and pile design. In Onshore structural design calculations (pp. 345–385). Elsevier. https://doi.org/10.1016/B978-0-08-101944-3.00008-5