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GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING(G+5) FOR "MARUTHAM DEVELOPER" AT S.F No.368/2, SASI AVENUE IN KALAPATTI, COIMBATORE-641 048.

REPORT BY:

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5/7, ANANDHA NAGAR,
VADAVALLI- 641041
COIMBATORE, TAMILNADU, INDIA.
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NS GEO SOLUTIONS

SOIL AND FOUNDATION EXPERTS

NS GEO
COIMBATORE

GEOTECHNICAL INVESTIGATION REPORT

PROJECT : **GEOTECHNICAL INVESTIGATION REPORT FOR PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING(G+5) FOR "MARUTHAM DEVELOPER" AT S.F No.368/2, SASI AVENUE IN KALAPATTI, COIMBATORE.**

B.H No	LATITUDE	LONGITUDE
01	11.047058°	77.028958°
02	11.047062°	77.028957°
03	11.047559°	77.028645°

REPORT No	DATE	REV
054/NS/2022	22.11.22	00

CLIENT DETAILS:

M/s MARUTHAM DEVELOPER,
S.F No.368/2,
SASI AVENUE,
KALAPATTI,
COIMBATORE -641 048.

Reg : Proposed construction of the Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.

The NS Geo Solutions, Coimbatore has completed the geotechnical exploration services for the above mentioned project.

This geotechnical investigation report presents the results of the subsurface exploration and provide geotechnical recommendations, design recommendations for your structure foundation are presented here in final form together with a summary of field and laboratory data.

We appreciate the opportunity to be of service to you on this project. If you have any comments concerning this report or if we may be of further services, please contact us.

Yours sincerely,
NS GEO SOLUTIONS.

R. SAGOUL M.E.(Geotech)
Registered Geo - Technical Engineer,
GTE /2022/07/56
Chennai Metropolitan Development Authority
Chennai

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INTRODUCTION

This report presents the results of the geotechnical investigations carried out by N S Civil Engineering Solutions, Coimbatore. A detailed soil investigation report was requested by the client for obtaining the soil profile and recommendation of most suitable foundation system for the proposed construction of Residential Apartment Building(G+5). The report comprises of the details of soil investigation, analysis of field and lab test results and recommendation of most suitable foundation system. This **Geotechnical Investigation Report for Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.**

Standard Penetration Test with three number of bore holes were drilled at the site up to a maximum depth of 9.0m below existing ground level. The investigation consists of drilling three boreholes, soil sampling, field and laboratory testing and preparation of the Geotechnical Investigation Report for Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.

The proposed site has plain terrain in which the bore hole has been tested in plain ground. The site was cleaned while the starting of geotechnical investigation. The total number of bore holes have been decided as 3 as agreed by the Client and the Consultant. The bore hole has been located in the maximum loaded area of the proposed site, the locations of borehole were chosen by Client. The nature of field tests includes standard penetration tests, disturbed sampling through split spoon sampler, identification of different soil layers, and location of ground water table, complete logging of the borehole etc,. The depth of bore hole was terminated to a maximum depth of 9.0m from EGL.

SCOPE OF WORK

The scope of this investigation is to:

i) Determine the soil profile at the site, with ground water observation

ii) Recommend a suitable foundation system and safe bearing pressure at foundation level.

iii) Suggestion on backfill.

Three boreholes were drilled to a maximum depth of 9.0m. Soil samples were collected for visual identification, classification and laboratory testing. The bore log sub soil profile is presented in Appendix~A~

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DESCRIPTION OF THE SITE

This **Geotechnical Investigation Report for the Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.** The site consists of three bore holes at maximum loaded area.

EXPLORATION PROGRAM & TECHNIQUES

After the visual inspection of the site, the subsurface investigation was carried out as mentioned below: Three exploration boreholes were drilled to a maximum depth of 9.00m.

BH - 1 was started on 10.11.2022 and completed on 11.11.2022.

BH - 2 was started on 15.11.2022 and completed on 15.11.2022.

BH – 3 was started on 16.11.2022 and completed on 16.11.2022.

Rotary drilling was performed using water as drilling fluid in the sub soil with casing pipe to stabilize the borehole up to the required depth. Field testing and sampling were conducted in accordance with IS: 2131-1981.Standard Penetration Test (SPT) was performed on the sub soil. In this test, a standard split spoon of length about 450 mm and cutting edge diameter of 51/35 mm initially penetrates the soil for 15cm to bypass the expected accumulated sludge at the bottom of the hole by means of a 63.5 kg (140 lb) hammer falling freely along a guide from a height of 750 mm. The total number of rows of blows (N) required, advancing the spoon into the bore, for another three successive 15cm (a total of 30 cm) is recorded as a measure of the soil relative density or consistency as given in Table ~A~ Along with, for further drilling using NX impregnated Tungsten Carbide cutter to be used to a depth till Weathered rock and NX impregnated Diamond cutter to be used in case of hard rock.

The fieldwork was carried out under the ***N S Civil Engineering Solutions*** and representative from client in accordance with Indian Standard mentioned earlier. The drilling rig used for the exploration is calyx rig with hand operated machine, so the SPT done manually on inspection of our engineer.

LABORATORY TESTING:

The soil samples obtained by way of Spoon Samples and core recoveries were analysed in the Geotechnical Engineering laboratory for its classification and the results are shown in the borehole logs.

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SUB SURFACE SOIL DESCRIPTION

Based on borehole information, sub surface soil profile for the **Geotechnical Investigation Report for Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.**

Bore hole no: 1

In BH-1, top soil consists of Poorly graded Sand(SP) from 1.5m to 1.95m which is followed by Poorly graded Gravel(GP) from 3.0m to 3.45m which is followed by Soft Weathered Rock(SWR) from 4.0m to 9.0m.

Bore hole no: 2

In BH-2, top soil consists of Poorly graded Sand(SP) from 1.5m to 1.95m which is followed by Poorly graded Gravel(GP) from 3.0m to 3.45m which is followed by Soft Weathered Rock(SWR) from 3.5m to 8.0m.

Bore hole no: 3

In BH-3, top soil consists of Poorly graded Gravel(GP) from 1.25m to 1.5m which is followed by Soft Weathered Rock(SWR) from 1.5m to 4.5m which is followed by Soft Disintegrated Rock(SDR) from 4.5m to 6.0m.

GROUND WATER

Ground water table was not found up to the depth of 9.0m at any bore hole.

COMPUTATION OF BEARING CAPACITY AND SETTLEMENT

Bearing capacity and settlement of the proposed Residential Apartment Building(G+5) is computed by assuming the depth of foundation as 3.0m,4.0m and 5.0m from the existing ground level. From the borehole data, the least 'N' values was taken for each depth and attempts are made to determine the bearing capacity and settlement for borehole data. The bearing capacity and settlement calculations are carried out to suggest the most suitable foundation system for the proposed Residential Apartment Building(G+5), keeping the depth of foundation as 3.0m,4.0m and 5.0m and width of foundation as 2.0m.

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Allowable Bearing Capacity

The design shear strength parameters ('c' and 'Φ' values) below the foundation depth of 3.0m,4.0m and 5.0m are calculated. Using Bureau of Indian Standard IS 6403-1981 equation, the allowable bearing capacity computed for three boreholes for an allowable settlement of 30 mm.

Settlement of Soil Layer

One of the important aspects of any foundation system is to satisfy the settlement criteria apart from bearing capacity criteria. In order to determine the settlement for 2.0m breadth foundation, IS 8009 (Part 1)-1976 is used. The settlement of soil layers below 3.0m,4.0m and 5.0m, depth of foundation is calculated up to '2B' of foundation.

FOUNDATION RECOMMENDATIONS

Based on the borehole information and laboratory test results in addition to the nature of structure, the recommendations for the proposed structure are given below. One of the important aspects of any foundation system is to satisfy the settlement criteria apart from bearing capacity criteria. As per IS 8009 (part I) 1976 settlement calculations are done.

Shallow foundation (Isolated footing or combined footing)

The following is a summary of recommendations for suitable type of foundations for **Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.**

Depth of Foundation (m)	Safe Bearing Capacity (kN/m²)
3.0m	260
4.0m	297
5.0m	329

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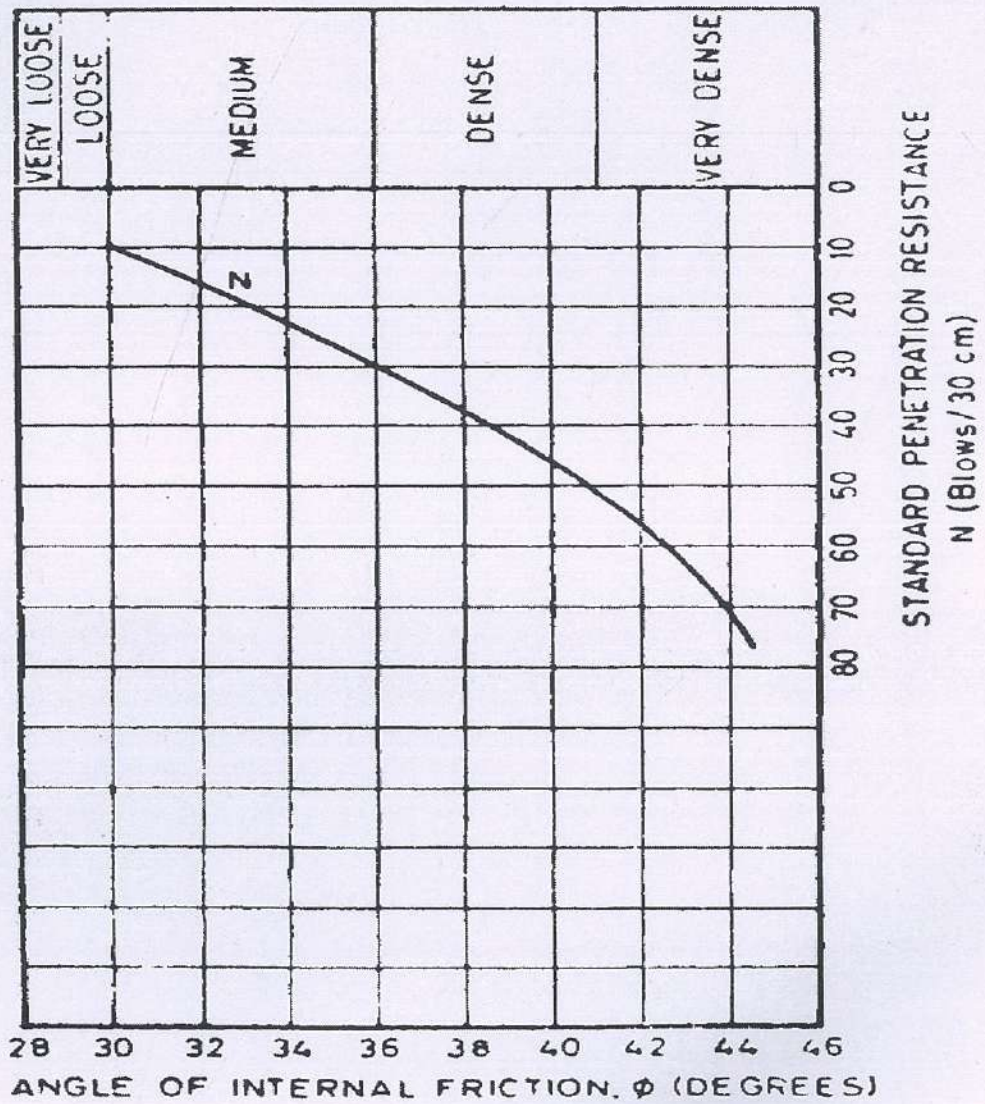


FIG. 1 RELATIONSHIP BETWEEN ϕ AND N

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TABLE 1 BEARING CAPACITY FACTORS

(*Clause* 5.1.1)

ϕ (Degrees)	Bearing Capacity Factors		
	N_c	N_q	$N\gamma$
0	5·14	1·00	0·00
5	6·49	1·57	0·45
10	8·35	2·47	1·22
15	10·98	3·94	2·65
20	14·83	6·40	5·39
25	20·72	10·66	10·88
30	30·14	18·40	22·40
35	46·12	33·30	48·03
40	75·31	64·20	109·41
45	138·88	134·88	271·76
50	266·89	319·07	762·89

NOTE — For obtaining values of N'_c, N'_q and $N'\gamma$, calculate $\phi' = \tan^{-1}(0.67 \tan \phi)$. Read N_c, N_q, and $N\gamma$, from the Table corresponding to the value of ϕ' instead of ϕ which are values of N'_c, N'_q, $N'\gamma$ respectively.

TABLE 2 SHAPE FACTORS

Sl No.	Shape of Base	Shape Factor		
		s_c	s_q	$s\gamma$
i)	Continuous strip	1·00	1·00	1·00
ii)	Rectangle	$1+0.2\,B/L$	$1+0.2\,B/L$	$1-0.4\,B/L$
iii)	Square	1·3	1·2	0·8
iv)	Circle	1·3	1·2	0·6

Use B as the diameter in the bearing capacity formula.

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5.1.2.2 The depth factors shall be as under:

$d_c = 1 + 0{\cdot}2\ D_f/B\ \sqrt{N\phi}$

$d_q = d\gamma = 1$ for $\phi < 10°$

$d_q = d\gamma = 1 + 0{\cdot}1\ D_f/B\sqrt{N\phi}$ for $\phi > 10°$

NOTE — The correction is to be applied only when back filling is done with proper compaction.

5.1.2.3 The inclination factor shall be as under:

$$i_c = i_q = \left(1 - \frac{\alpha}{90}\right)^2$$

$$i\gamma = \left(1 - \frac{\alpha}{\phi}\right)^2$$

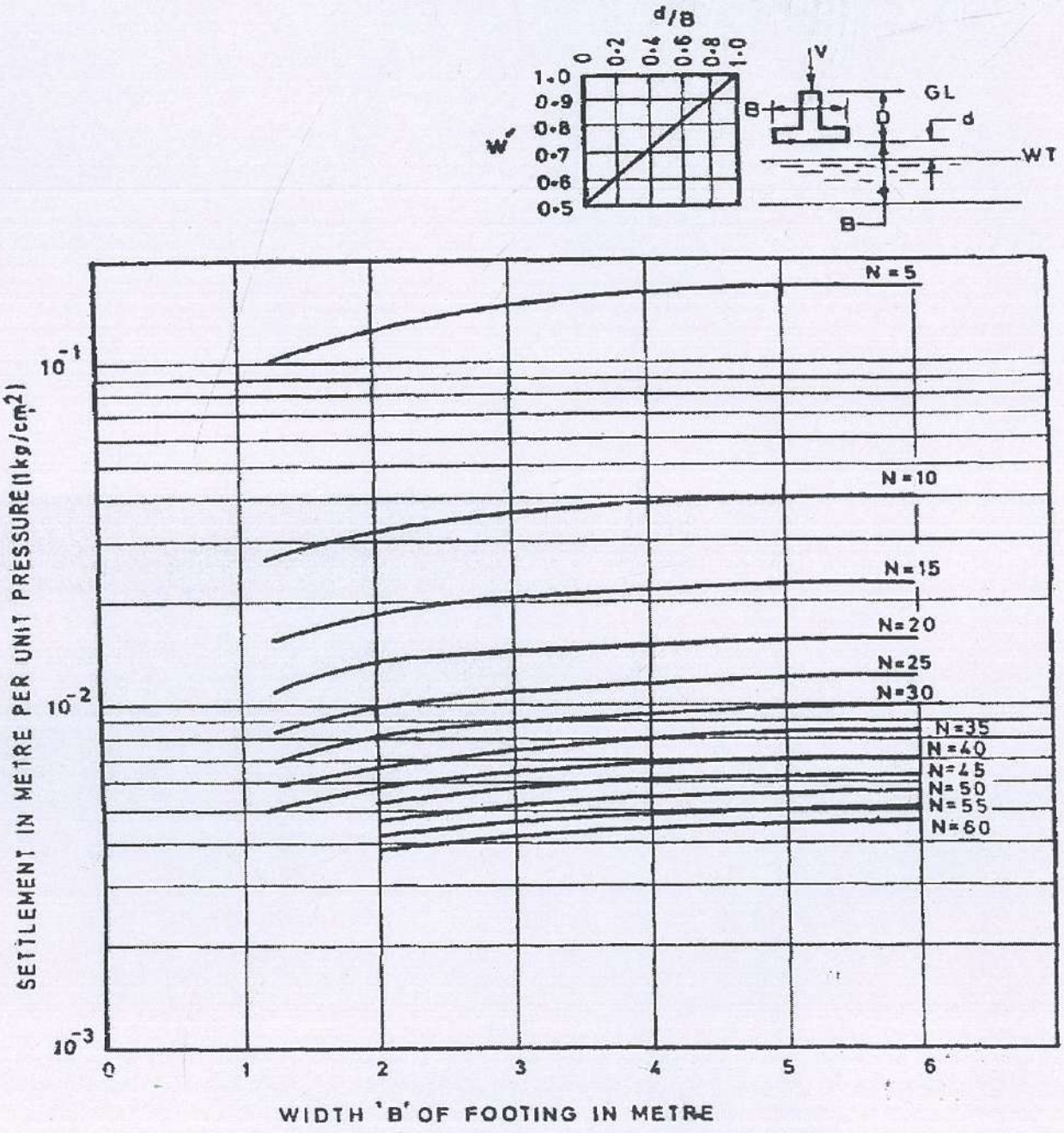
5.1.2.4 *Effect of water table*

a) If the water table is likely to permanently remain at or below a depth of $(D_f + B)$ beneath the ground level surrounding the footing then $W' = 1$.

b) If the water table is located at a depth D_f or likely to rise to the base of the footing or above then the value of W' shall be taken as 0·5.

c) If the water table is likely to permanently got located at depth $D_f < D_w < (D_f + B)$, then the value of W' be obtained by linear interpolation.

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GL = Ground level. WT = Water table.

FIG. 9 SETTLEMENT PER UNIT PRESSURE FROM STANDARD PENETRATION RESISTANCE

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Type of Material	Safe Bearing Capacity, kPa
1. Soft Rock or Shale	440
2. Gravel, sandy gravel, silty sandy gravel; very dense and offer high resistance to penetration during excavation (soil shall include the groups GW, GP, GM, GC)	400**
3. Sand (other than fine sand), gravelly sand, silty sand; dry (soil shall include the groups SW, SP, SM, SC)	200**
4. Fine sand; loose & dry (soil shall include the groups SW, SP)	100**
5. Silt, clayey silt, clayey sand; dry lumps which can be easily crushed by finger (soil shall include the groups ML, MI, SC, MH)	150
6. Clay, sandy clay; can be indented with strong thumb pressure (soil shall include the groups CL, CI, CH)	150
7. Soft clay; can be indented with modest thumb pressure (soil shall include the groups CL, CI, CH)	100
8. Very soft clay; can be penetrated several centimeters with thumb pressure (soil shall include the groups CL, CI, CH)	50
9. Organic clay & Peat (soil shall include the groups OI, OH, OL, Pt)	To be determined after investigation.
10. Fills	To be determined after investigation.

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Model sample for SBC calculation:

Bore hole number	01
Depth	3.0m
SPT value,(N)	50
Breadh of footing,(B)	2.0m
Depth of footing,(D_f)	3.0m

Shear criteria:

Net Ultimate bearing capacity, (q_{nu})

q_{nu} $= 1.3CN_c + q(N_q - 1) + 0.4B\gamma N_\gamma$

C - Cohesion

q - $\gamma * D_f$

W - water table correction factor(0.5 for worst case)

N_c, N_q, N_γ - Bearing Capacity factor depends on ϕ (from IS 6403:1981)

d_c, d_q, d_γ - Depth factor from IS 6403:1981

i_c, I_q, i_γ - Inclination factor from IS 6403:1981

S_c, S_q, S_γ - Shape factor from IS 6403:1981

ϕ - Angle of internal friction which is get from N value (from IS 6403)

For N=35 and ϕ=36

N_c=46.12	N_q =33.30	N_γ=48.03
d_c= 1.49	d_q = 1.24	d_q= 1.24
S_c= 1.3	S_q=1.3	S_γ=1.3 (assuming Square footing)
i_c = 1	i_q = 1	i_γ= 1

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Taking, Unit weight , γ	$=10kN/m^3$
Net ultimate bearing capacity, q_{nu}	$= 10*3.0* (33.30-1)+0.4*10*2.0*48.03$
	$=1353kN/m^2$
Safe Bearing Capacity q_s	$= q_{ns}/F.O.S$
Factor of safety,(F.O.S)	$= 3.5$
Safe Bearing capacity q_s	$= 386kN/m^2$

Settlement Criteria:

Observed SPT 'N' value	= 50
As per IS 8009(part1)-1976, from Fig 9 in IS 8009	
For Breadh, B (max)	= 2.0m
Settlement/Unit pressure	$=0.0068$ m/(kg/cm^2)
Water table correction factor	= 0.5
For settlement of 25mm	
Unit pressure	$=25*0.5/ 4.8$
Allowable Bearing pressure	= 2.60kg/cm^2..... (2)

Safe bearing capacity is taken as minimum of Shear criteria (1) and settlement criteria (2).

Allowable Bearing capacity = 260kN/m^2

GENERAL GUIDELINES IN SOIL FILLING

If the foundation material is fine soil (clay and silt) it should be stiff. If the foundation soil is coarse-grained (sand or gravel) it should be dense. Soft, loose, compressible, or organic top soils are not acceptable.

For foundation ,in such cases the existing weak soil should be replaced up to stiff or dense soil strata below the foundation with well compacted good quality granular soil. The minimum width of replacement shall be length of reinforcement plus 1 meter and this will ensure that the foundation soil has sufficient bearing capacity to withstand bearing pressures in both static and as well as seismic conditions. The foundation may be located on the compacted granular soil fill.

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GENERAL COMMENTS

The recommendations for foundation design and construction are based on the information obtained from the boreholes drilled at site. When foundation construction is underway, the recommendations of this report should be checked through field inspection, to validate the information for use during the construction stage. Any variation in underground conditions revealed by the borehole should be brought to our attention for alternate recommendations, if needed. The Professional Services performed for the preparation of report were accomplished in accordance with current and locally accepted geotechnical engineering principles and practices. The recommendations presented in this report are based upon the data obtained from the borings at the indicated locations and/or from other information discussed in this report. In case of pile foundation the pile must to be rests on the harder rock stratum, if the depth 1.00m is not strong the pile has to be advanced to till the harder rock stratum.

EXCAVATION

Excavation through the overburden soil can be carried out by conventional equipment such as dozers and poclain excavators. Under-excavation shall not be done, thereby not to disturb the existing foundation. Since the proposed structure is nearby the existingResidential Apartment Apartment Building (STILT+5) it should be care that existing foundation not to be disturbed in any causes

DRAINAGE

It is recommended to design an effective rainwater drainage system to get rid of the consequences of the rain water percolation into these layers. The site should be graded so as to direct rainwater and water away from all planned structures.

FOUNDATIONS ON FILLS

In such cases the foundations have to be built under controlled conditions with proper compaction can be designed as normal foundation. Uncontrolled fills should be excavated and they should be either refilled with controlled fill or foundation should commence from Natural ground level. The Report and SBC calculation were completely based on the bore holes terminated; apart from this any weak layer encountered during excavations should also be reported to N.S. Civil Engineering Solutions.

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CERTIFICATION

The total no. of pages in the report is 48, along with this design of **Shallow Foundation (Isolated footing or combined footing)** is to be suggested for **Proposed construction of Residential Apartment Building(G+5) at S.F No.368/2, Sasi Avenue in Kalapatti, Coimbatore.** The footing should be rest at the good bearing stratum. In this site, three number of bore holes were drilled and depth of exploration was also terminated to a maximum depth of 9.0m. The report is mainly based on the investigation done in and around bore holes explored for Residential Apartment Building(G+5). The suitable method of Ground improvement techniques should be adopted as per IS 13094:1992, before laying foundation System. Enough care may be taken to design a suitable dewatering system while construction of foundation is in progress, so that the bottom of excavation and foundation layer shall be relatively dry. The water seeking trees around the proposed structure is also to be removed to avoid shrinkage cracks. However, it is the sole discretion of the structural engineer / client to vary the depth considering the SBC and strata during excavation and design the structure accordingly, provided strictly adhering to the recommendations. Interpretations are provided based on factual field & Laboratory test results & shall be applicable for investigated locations. There is a possibility that strata variations could occur. If any variations indicate significant deviation from the findings of this report, same shall be brought to our notice.

Depth of Foundation (m)	Safe Bearing Capacity (kN/m^2)
3.0m	260
4.0m	297
5.0m	329

Yours Truly,

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Assistant Gde - Technical Engineer,
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APPENDIX - A

BORE LOG & SUB SOIL PROFILE

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GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT SASI AVENUE, KALAPATTI, COIMBATORE.

N.S CIVIL ENGINEERING SOLUTIONS
COIMBATORE.

CLIENT : M/s Maruthum Developer.
DIA & TYPE OF BORING : 100mm Rotary boring with drilling mud circulation
BORE HOLE NO : BH 01
GROUND WATER TABLE : Nil

BORING STARTED : 10.11.2022
BORING COMPLETED : 11.11.2022
LOCATION : Sasi Avenue, Kalapatti, Coimbatore.

DEPTH	PROFILE	DESCRIPTION OF STRATA	THICKNESS OF STRATA	DEPTH in "m"	TEST DEPTH in "m"	BLOWS / 15 cm			SPT "N"	REMARKS
						15 cm	15 cm	15 cm		
1.5m		Poorly graded Sand (SP)	0.45	1.5	1.5-1.95	10	10	12	22	D.S
3.0m		Poorly Graded Gravel (GP)	0.45	3.0	3.0-3.45	Wash Sample				TC Bit
4.0m		Soft Weathered Rock (SWR)	5.0	4.0	4.0-6.0	Broken Rock pieces				Diamond bit
				6.0	6.0-7.0	Broken Rock pieces				Diamond bit
				7.0	7.0-7.5	Broken Rock pieces				Diamond bit
				7.5	7.5-8.5	Broken Rock pieces				Diamond bit
				8.5	8.5-9.0	Broken Rock pieces				Diamond bit

D.S - DISTURBED SAMPLE

THE BORE HOLE IS TERMINATED AT 9.0m

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GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT SASI AVENUE, KALAPATTI, COIMBATORE.

N.S.CIVIL ENGINEERING SOLUTIONS
COIMBATORE.

CLIENT : M/s Manutham Developer,
DIA & TYPE OF BORING : 100mm Rotary boring with drilling mud circulation
BORE HOLE NO : BH 02
GROUND WATER TABLE : Nil

BORING STARTED : 15.11.2022
BORING COMPLETED : 15.11.2022
LOCATION : Sasi Avenue, Kalapatti, Coimbatore.

DEPTH	PROFILE	DESCRIPTION OF STRATA	THICKNESS OF STRATA	DEPTH in m	TEST DEPTH in "m"	BLOWS / 15 cm			SPT "N"	REMARKS
						15 cm	15 cm	15 cm		
1.5m		Poorly graded Sand (SP)	0.45	1.5	1.5-1.95	4	8	13	21	D.S
3.0m		Poorly Graded Gravel (GP)	0.45	3.0	3.0-3.45	Wash Sample				TC Bit
3.5m		Soft Weathered Rock (SWR)	5.5	3.5	3.5-4.0	Broken Rock pieces				Diamond bit
				4.0	4.0-4.5	Broken Rock pieces				Diamond bit
				4.5	4.5-7.5	Broken Rock pieces				Diamond bit
				7.5	7.5-8.0	Broken Rock pieces				Diamond bit

D.S - DISTURBED SAMPLE

THE BORE HOLE IS TERMINATED AT 8.0m

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GEOTECHNICAL INVESTIGATION FOR PROPOSED CONSTRUCTION OF RESIDENTIAL APARTMENT BUILDING AT SASI AVENUE, KALAPATTI, COIMBATORE.

N.S.CIVIL ENGINEERING SOLUTIONS COIMBATORE.	CLIENT : M/s Marutham Developer, DIA & TYPE OF BORING : 100mm Rotary boring with drilling mud circulation BORE HOLE NO : BH 03 GROUND WATER TABLE : Nil	BORING STARTED : 16.11.2022 BORING COMPLETED : 16.11.2022 LOCATION : Sasi Avenue, Kalapatti, Coimbatore.

DEPTH	PROFILE	DESCRIPTION OF STRATA	THICKNESS OF STRATA	DEPTH in m	TEST DEPTH in "m"	BLOWS / 15 cm			SPT "N"	REMARKS
						15 cm	15 cm	15 cm		
1.25m		Poorly Graded Gravel (GP)	0.25	1.25	1.25-1.50	Wash Sample				TC Bit
1.5m		Soft Weathered Rock (SWR)	2.5	1.5	1.5-3.5	Broken Rock pieces				Diamond bit
				3.5	3.5-4.0	Broken Rock pieces				Diamond bit
4.0m		Soft Disintegrated Rock (SDR)	2.0	4.0	4.0-4.5	Broken Rock pieces				Diamond bit
				4.5	4.5-5.0	Broken Rock pieces(L=14 cm)				Diamond bit
				5.0	5.0-6.0	Broken Rock pieces				Diamond bit

D.S - DISTURBED SAMPLE

THE BORE HOLE IS TERMINATED AT 6.0m

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Name of Project :	Subsoil Investigation for the construction of Residential Apartment building at Sasi Avenue in Kalapatti, Coimbatore

B.H: 02 **Depth** 1.5m

Report No : 054/NS/2022 **Date** 21.11.2022

Weight of soil taken **238 g**

S.No	Sieve Size (mm)	Weight Retained(gm)	Percentage of weight Retained (%)	Cumulative percentage Retaind (%)	Percentage of Finess (%)
1	4.75	12	5.04	5.04	94.96
2	2.36	23	9.66	14.71	85.29
3	1.18	60	25.21	39.92	60.08
4	0.6	41	17.23	57.14	42.86
5	0.3	48	20.17	77.31	22.69
6	0.15	47	19.75	97.06	2.94
7	0.075	6	2.52	99.58	0.42
8	Pan	1	0.42	100.00	0.00

Based on Gradation curve the following sizes of soil particles are obtained (As per IS 1498-1970)

Gravel = 5.04 %

Silt & Clay = 0.42 %

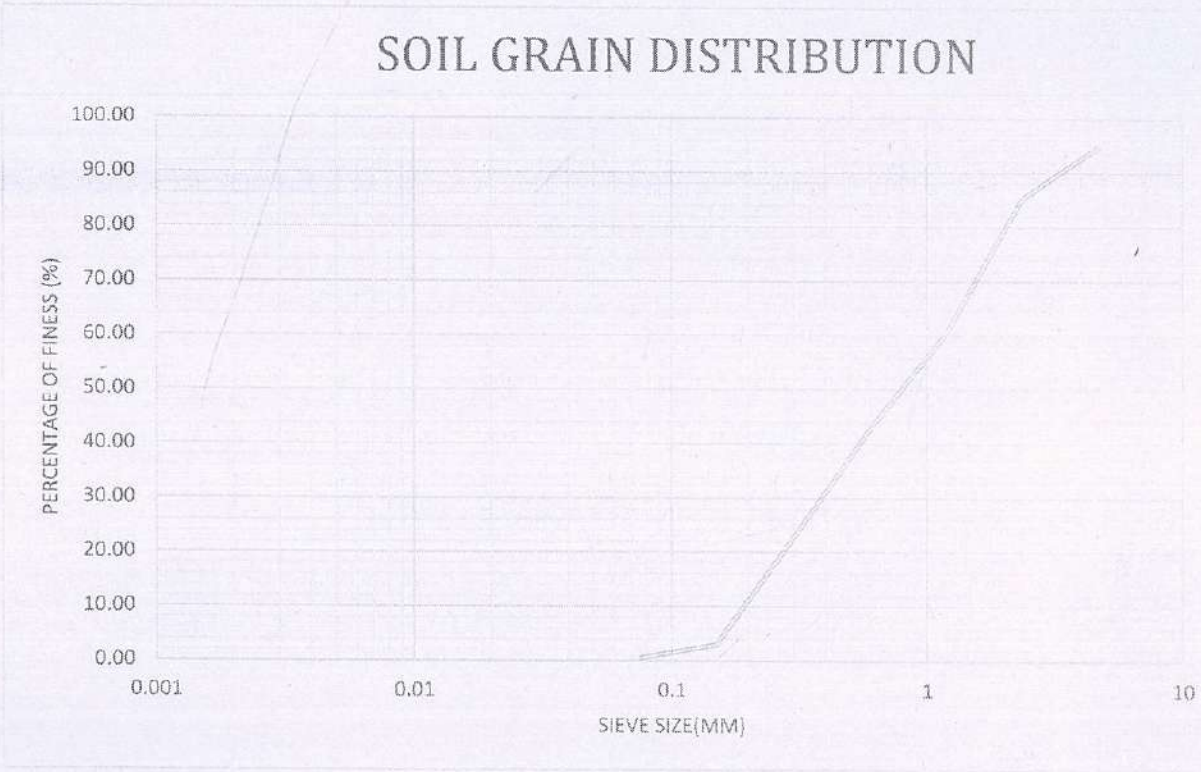
Sand = 94.54 %

Soil Description **Poorly graded Sand (SP)**

N. Ragg.

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SOIL GRAIN DISTRIBUTION



D_{10}	0.2
D_{30}	0.38
D_{60}	1.2

Coefficient of Uniformity, C_u	6.00
Coefficient of Curvature, C_c	0.60

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NOTE

ABBREVIATION:

WN	=	Natural Moisture content (%)
WL	=	Liquid limit (%)
WP	=	Plasticity Limit (%)
IP	=	Plasticity Index (%)
F.S.I	=	Free Swell Index (%)
IS	=	Indian Standard Classification
ML	=	Inorganic clay
CL	=	Low compressibility Clay of WL < 35%
CI	=	Inorganic Clay of 35% < WL <50%
CH	=	High Compressibility Clay of WL > 50%
SW	=	Well graded sand
SP	=	Poorly graded sand
GW	=	Well graded gravel
GP	=	Poorly graded gravel

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Table No: A.

Correlations of SPT N values with Common properties of soils

A) Granular Soil

Standard Penetration No., SPT N	Description	Relative Density, %	Approx. Angle of Internal Friction, Φ	Approx. Rang of Most. Unit Wt.,kN/m^3
<4	Very loose	20	29	11-16
4-10	Loose	20-40	29-30	14-18
10-30	Medium	40-60	30-36	17-20
30-50	Dense	60-80	36-41	17-22
>50	Very Dense	80	41	20-29

B) Cohesive Soil

Standard Penetration No., SPT N	Description	Unconfined Compressive Strength, kPa	Approx. Rang of Most. Unit Wt., kN/m^3
< 2	Very Soft	0-25	14.4-16
2-4	Soft	25-50	16-17.4
4-8	Firm (medium)	50-100	17.6-19.2
8-15	Stiff	100-200	19.2-20.8
15-30	very Stiff	200-400	20.8-22.4
>30	Hard	> 400	> 20

Note:

These values are most appropriate values in general. However, the soil properties vary between sites to site and hence it shall be used only for guidance

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List of code books as followed

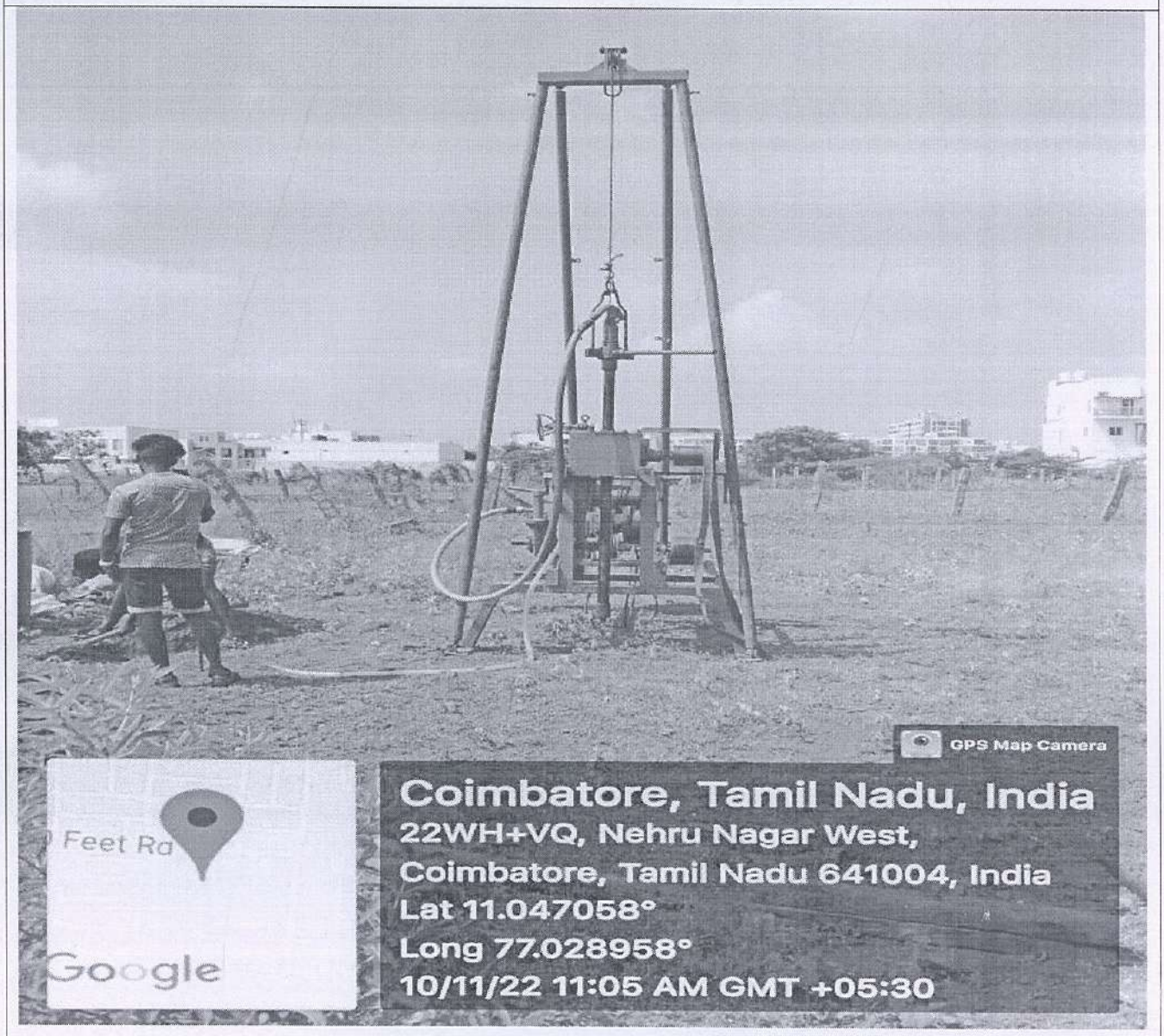
S.NO	IS CODES	DESCRIPTION
1	IS 6403:1981	code of practice of determination of bearing capacity of shallow foundation
2	IS 8009 (part I)-1878	code of practice for calculations of settlements of foundations
3	IS 12070 (1987)	code of practice for design and construction of shallow foundation on rocks
4	IS 13063:1991	structural safety of Building on shallow foundation on rocks
5	IS:2911 (PART III)-1980	code of practice for design and construction of pile foundation under reamed piles
6	IS:2911 (PART II)-1980	code of practice for design and construction of pile foundation Bored cast in situ pile
7	IS 2911 Part IV-1980	code of practice for design and construction of pile foundation Plate load test
8	IS 13094:1992	Selection of ground improvement techniques for foundation in weak soils Guidelines
9	IS 8764 (1998)	Method of Determination of Point load Strength index of rocks
10	IS 13030:1981	Method of test for laboratory determination of water content , Porosity ,Density and related Properties rock materials
11	IS 5878- part v-1976	Code of practice for construction of Tunnels conveying water- concrete lining
12	IS 5878-part II-1976	Underground excavation in rocks
13	IS 5878- part II- 1976 section 1	Drilling and Blasting
14	IS 5878- part II-1976 section 2	Ventilation, Light and dewatering

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SITE SOIL SAMPLE PHOTOS

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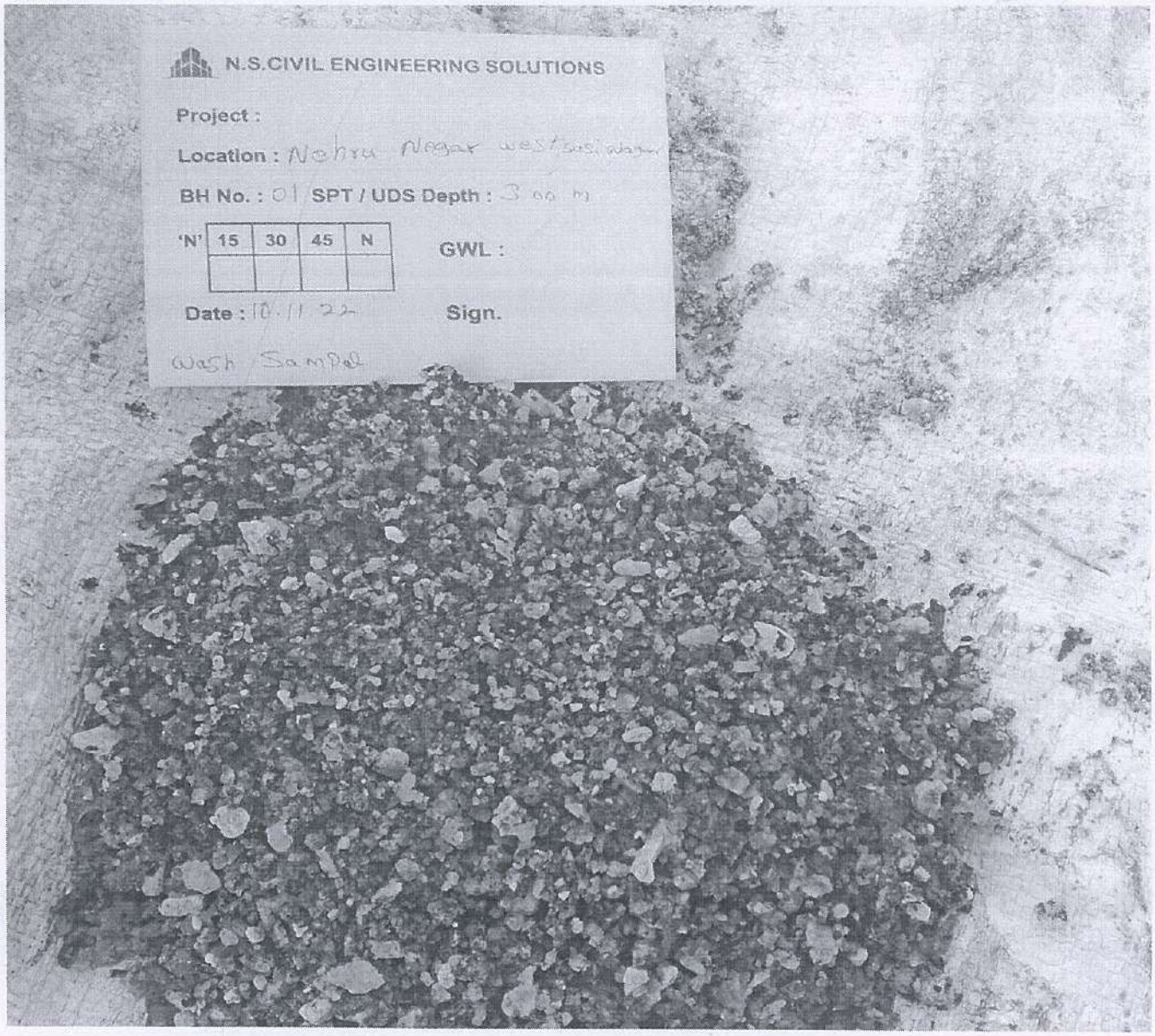
B.H 01



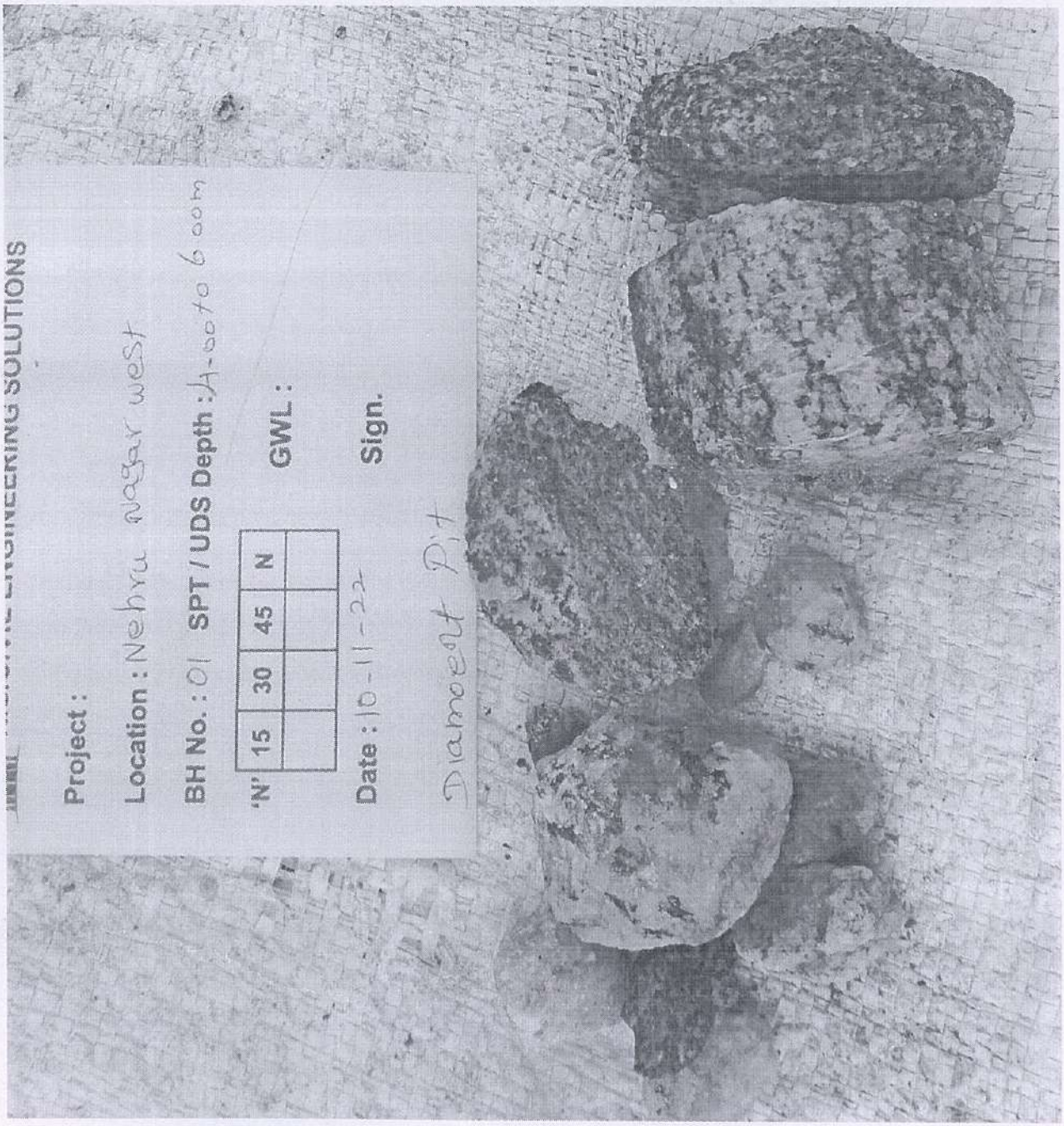
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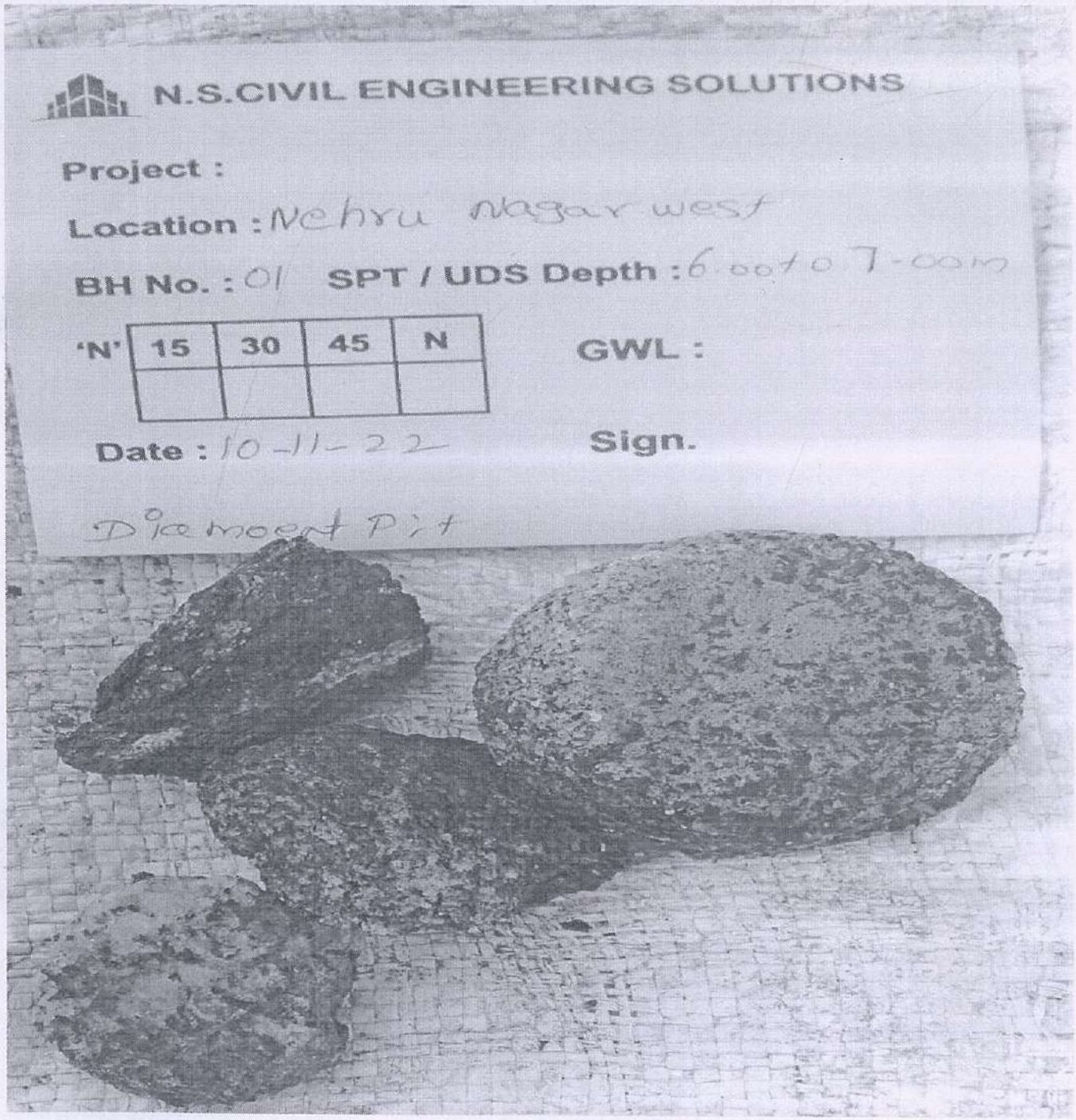
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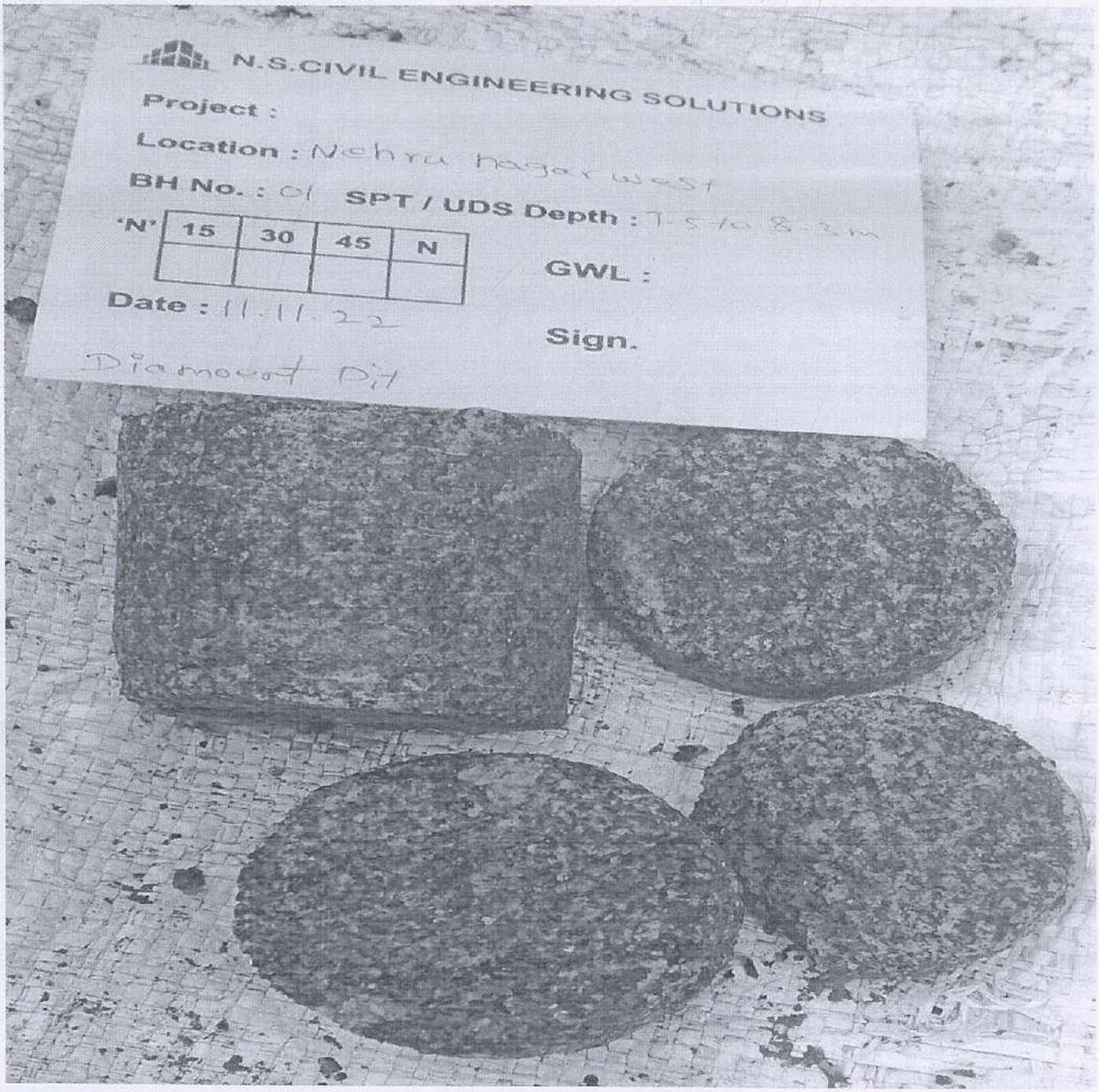
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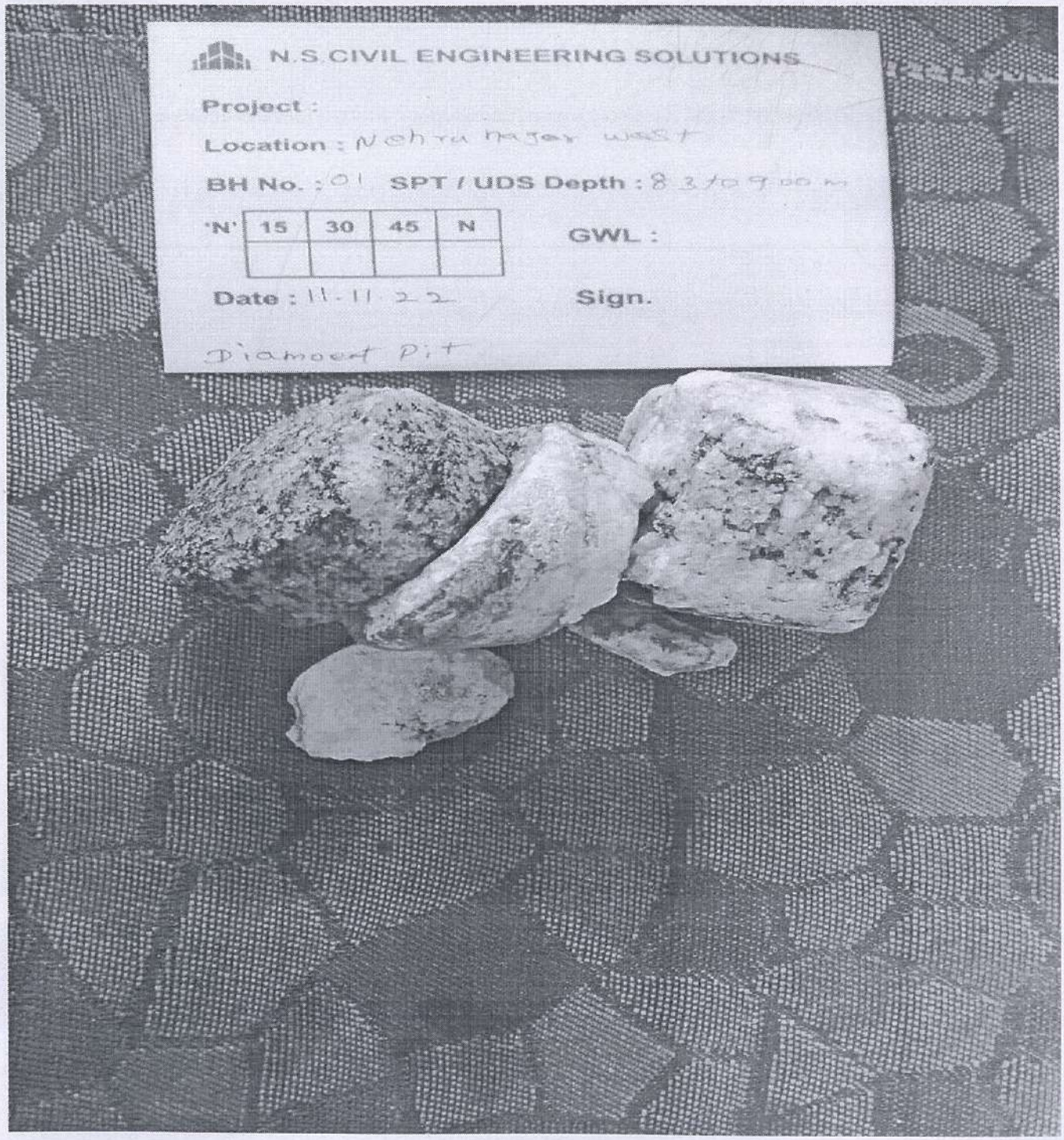
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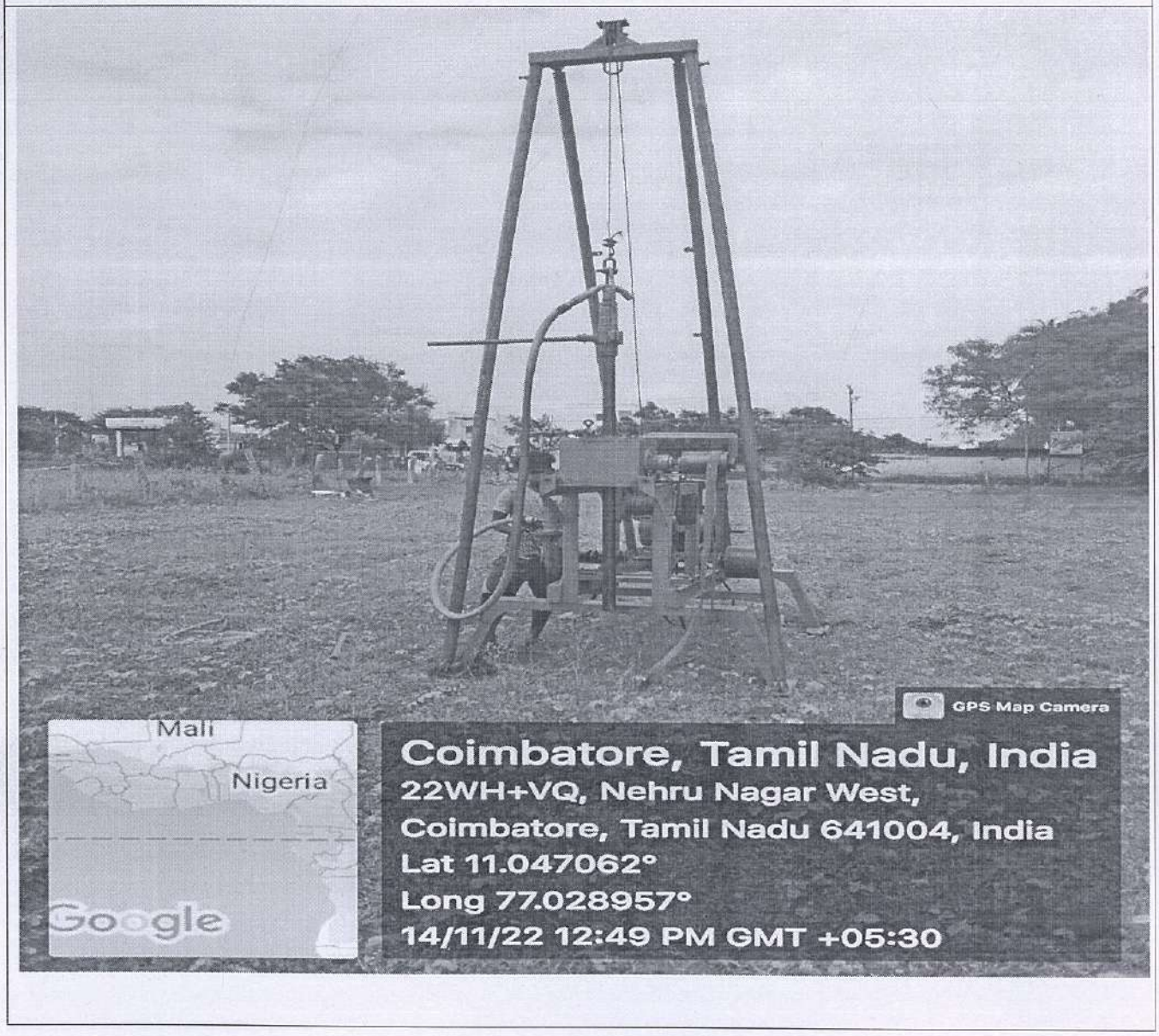


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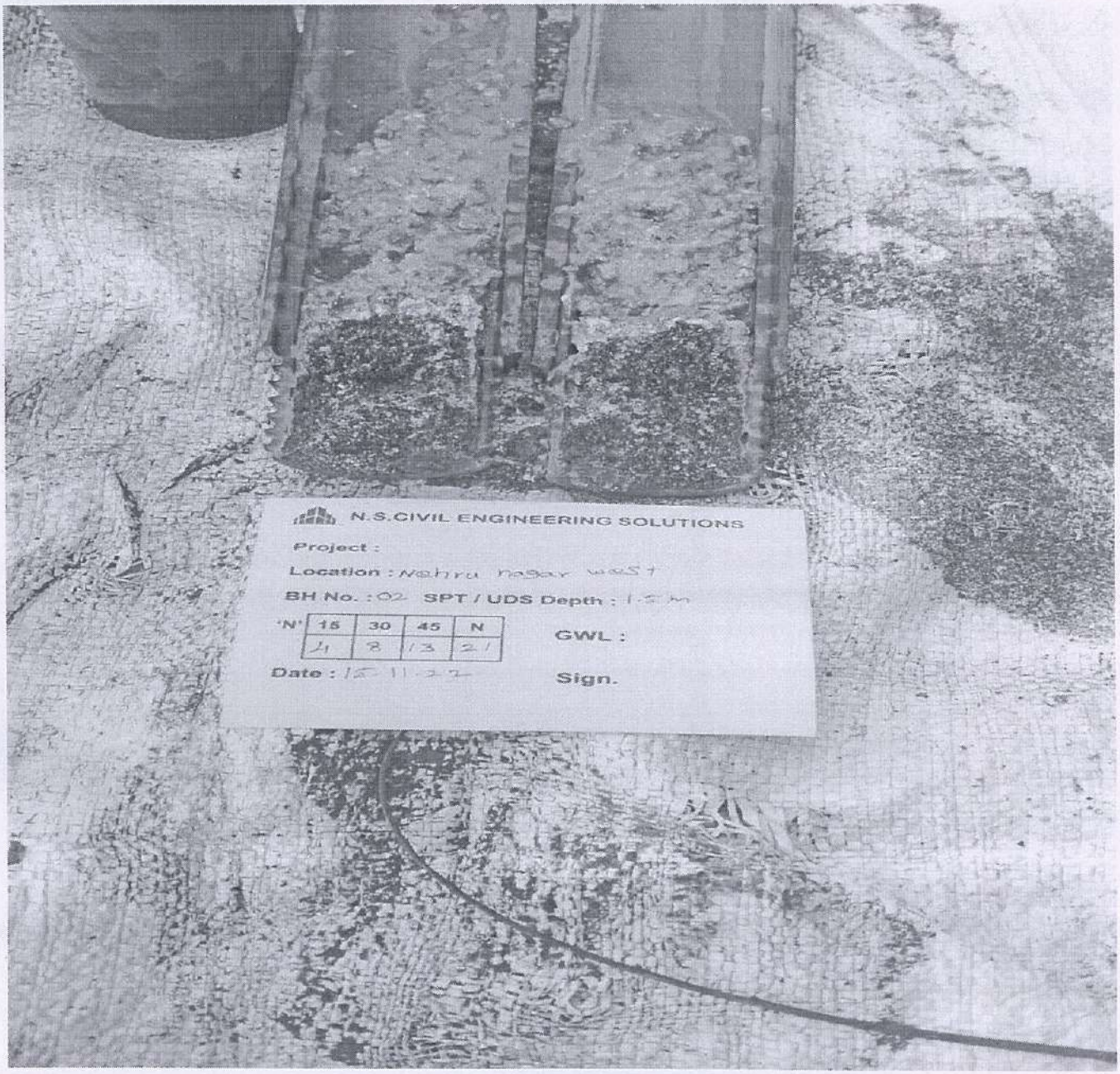


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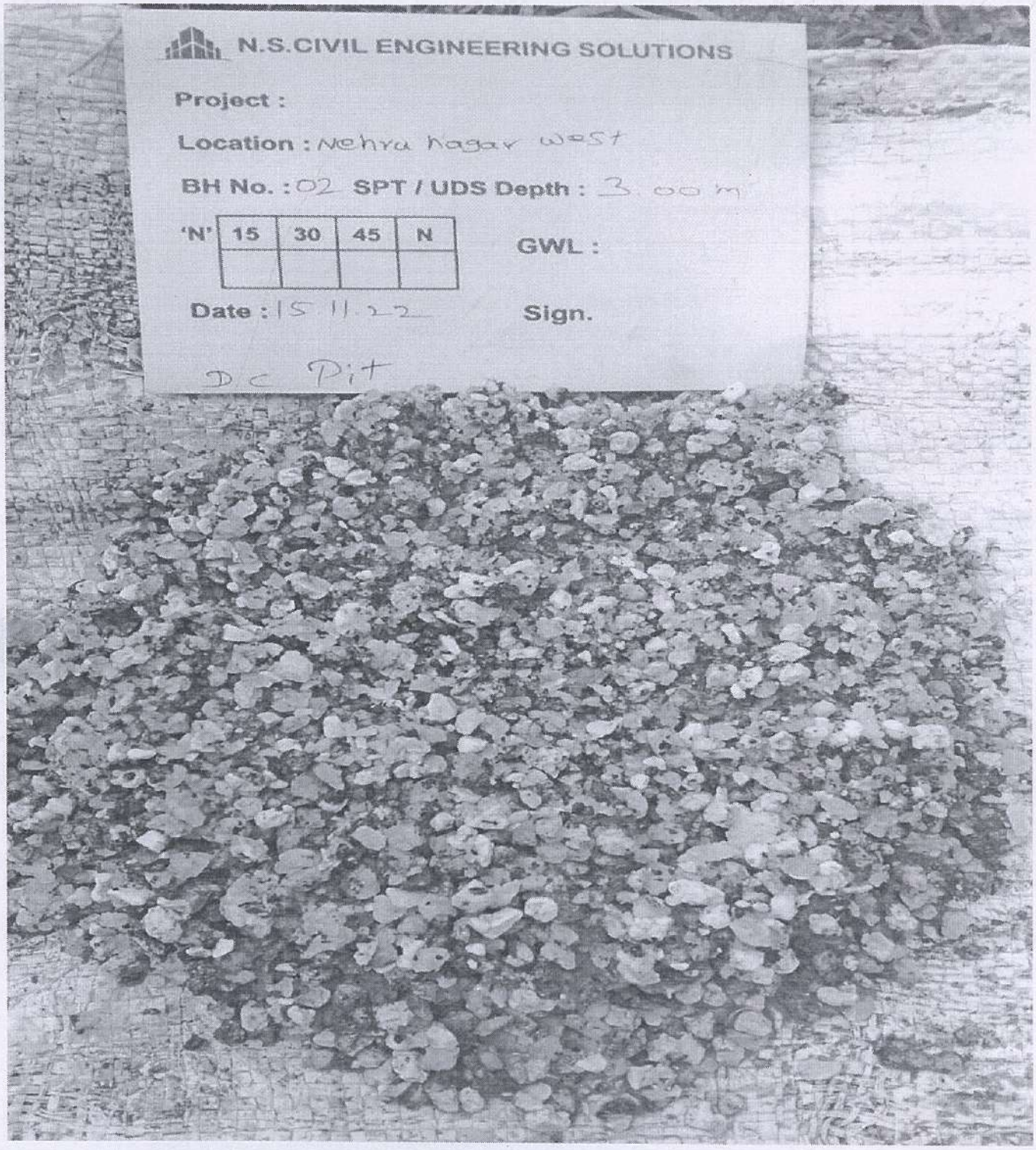
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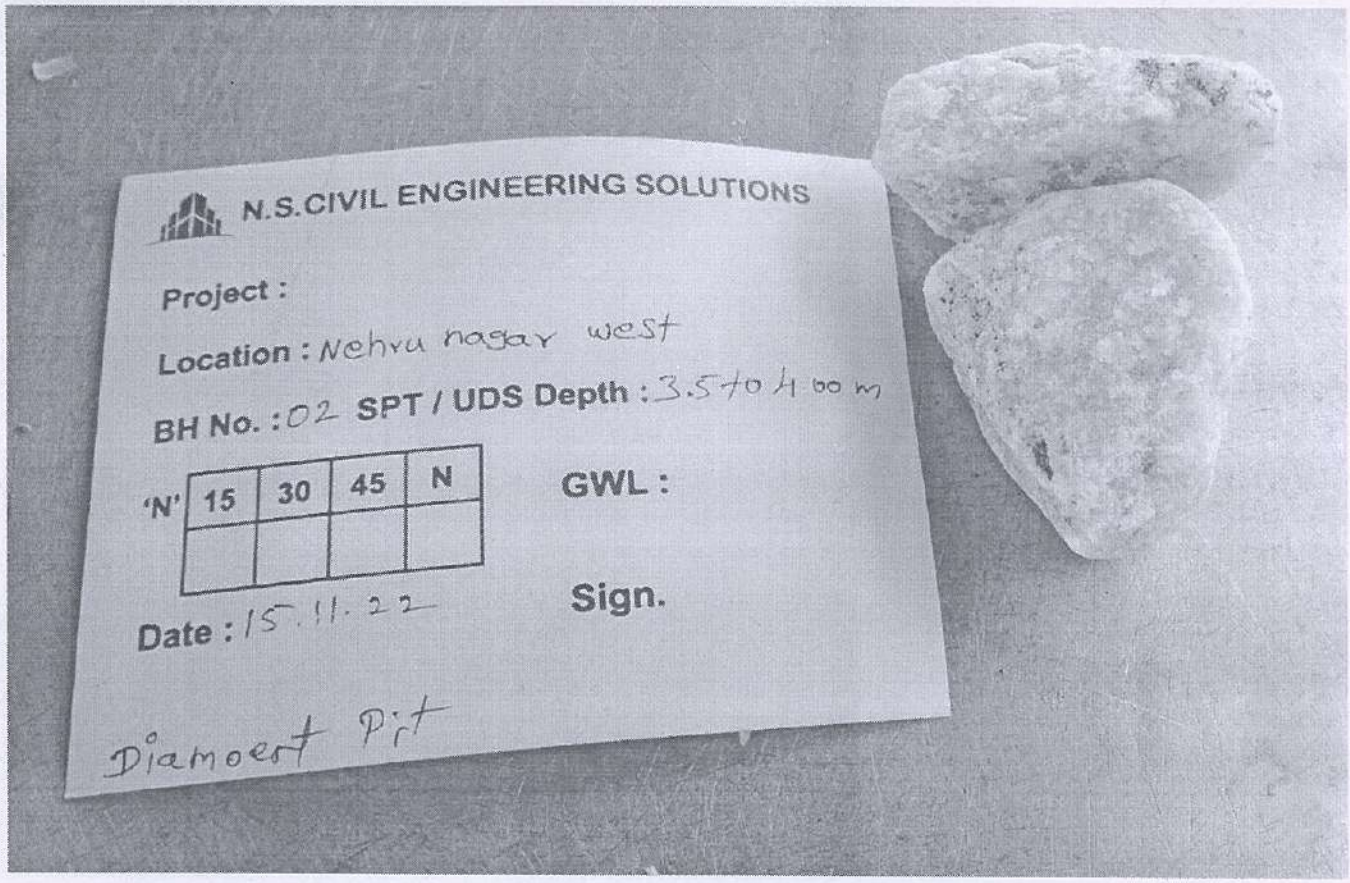
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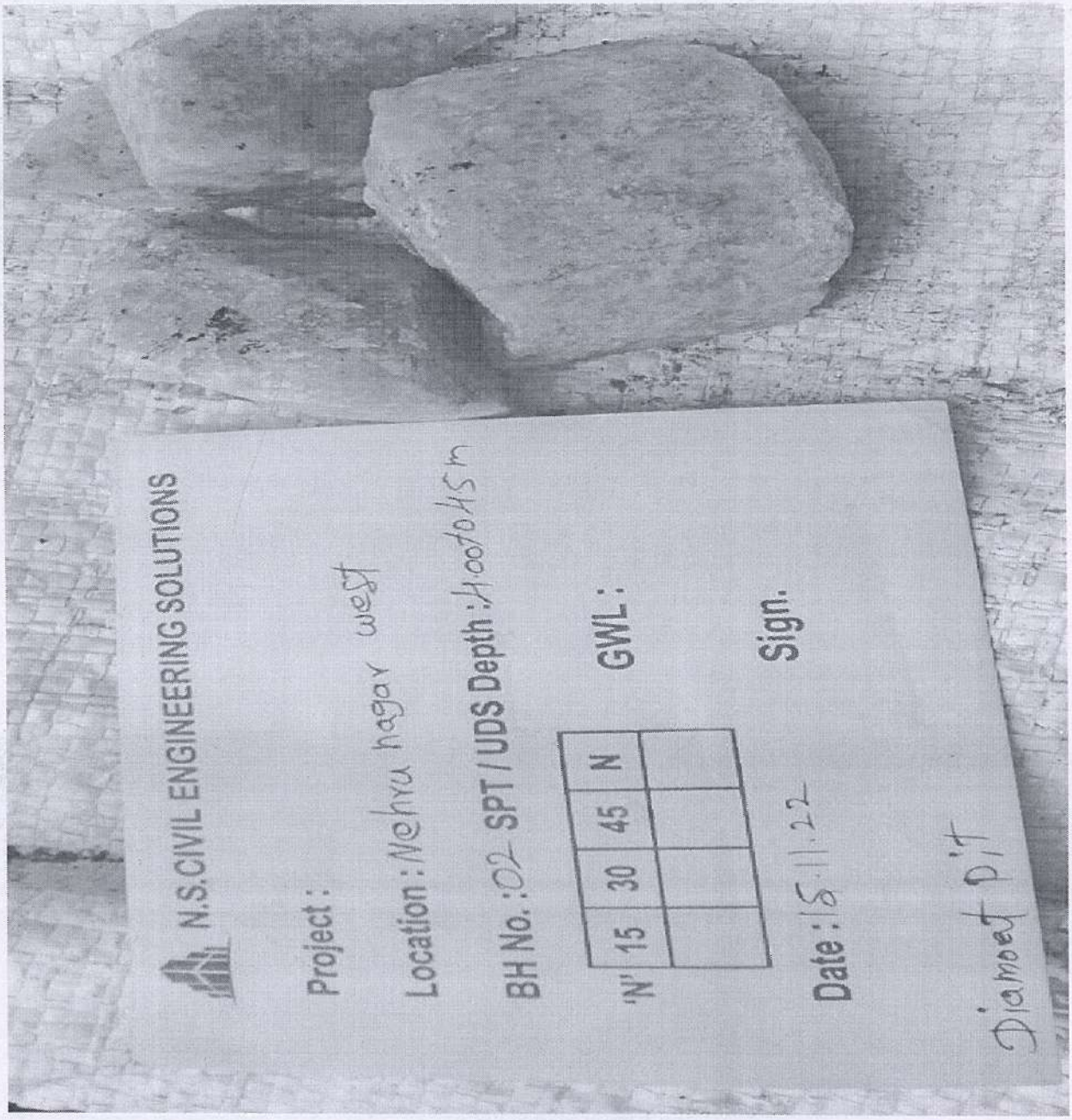
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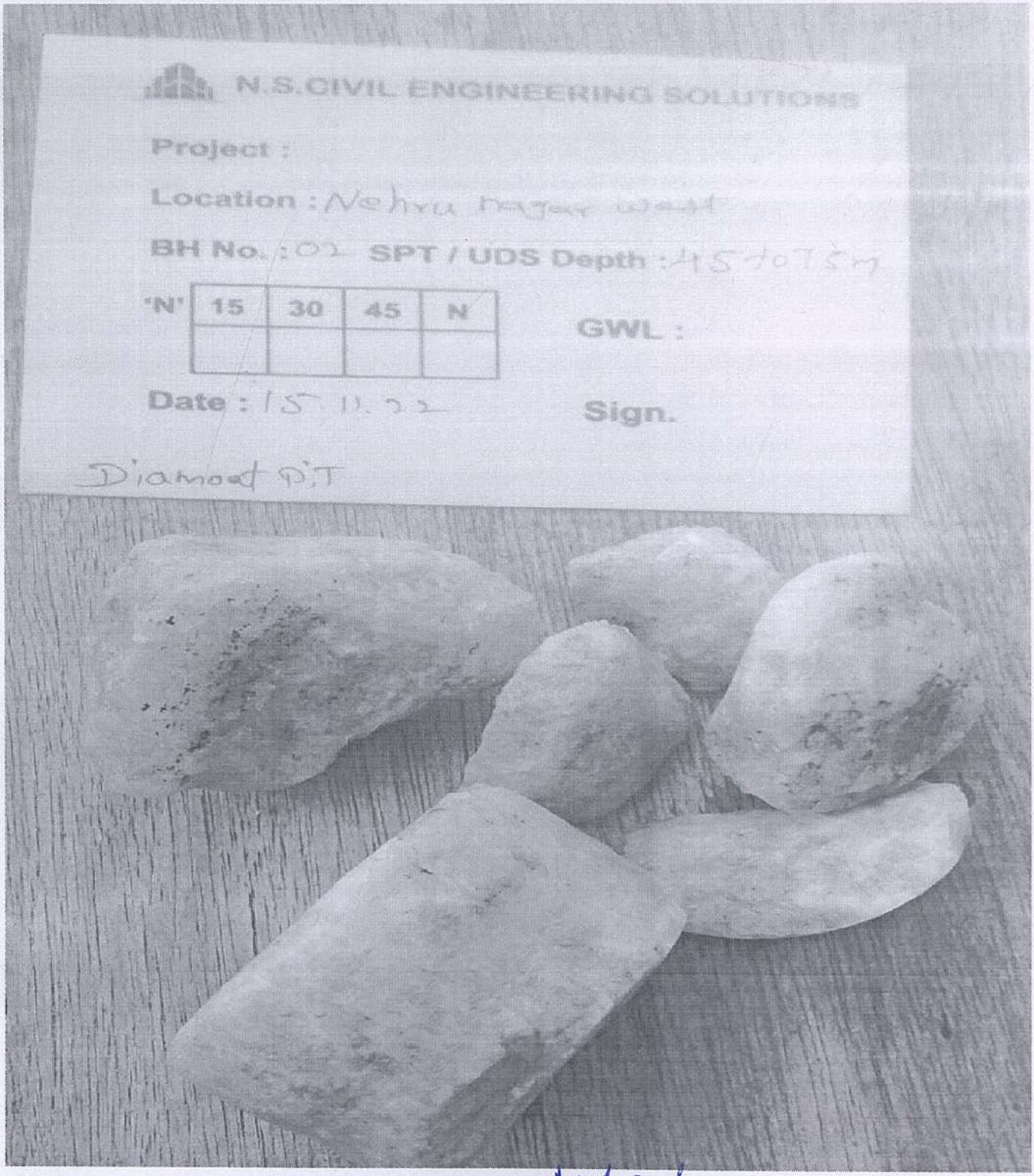
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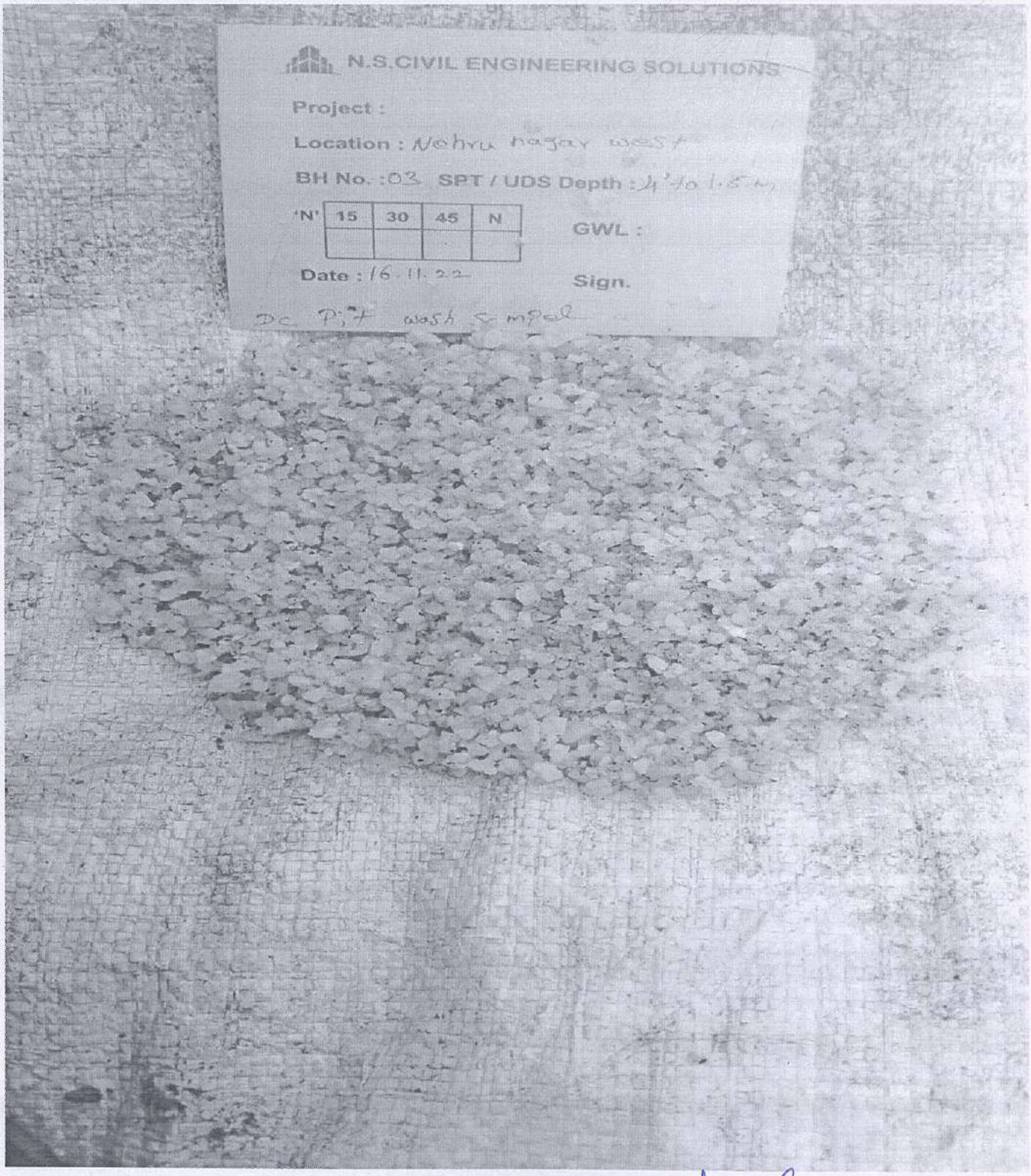


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B.H 03



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N.S.CIVIL ENGINEERING SOLUTIONS

Project :

Location : Nehru nagar west

BH No. :03 SPT / UDS Depth : 1.5 to 3.0m

'N'	15	30	45	N

GWL :

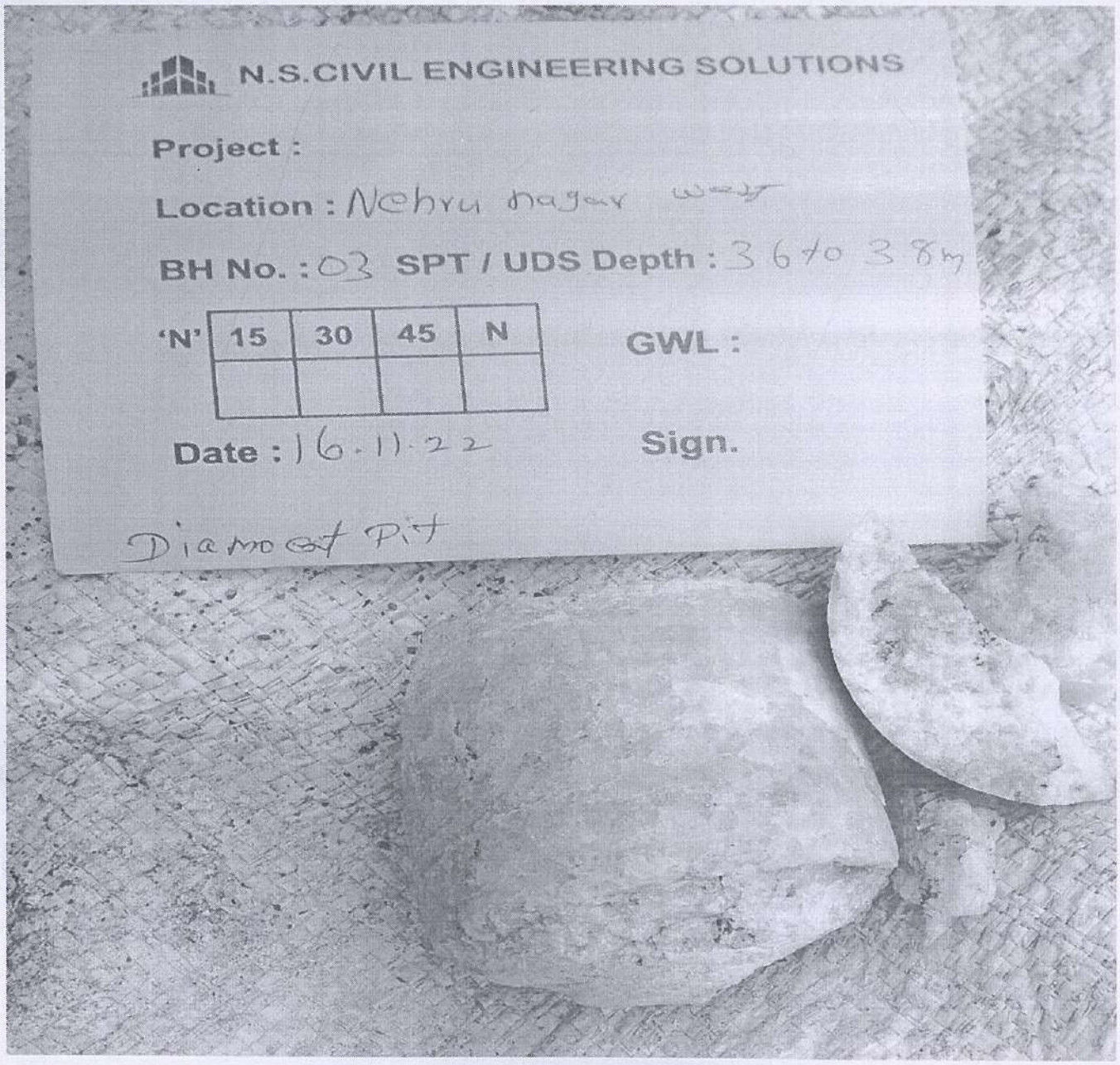
Date : 16.11.22

Sign.

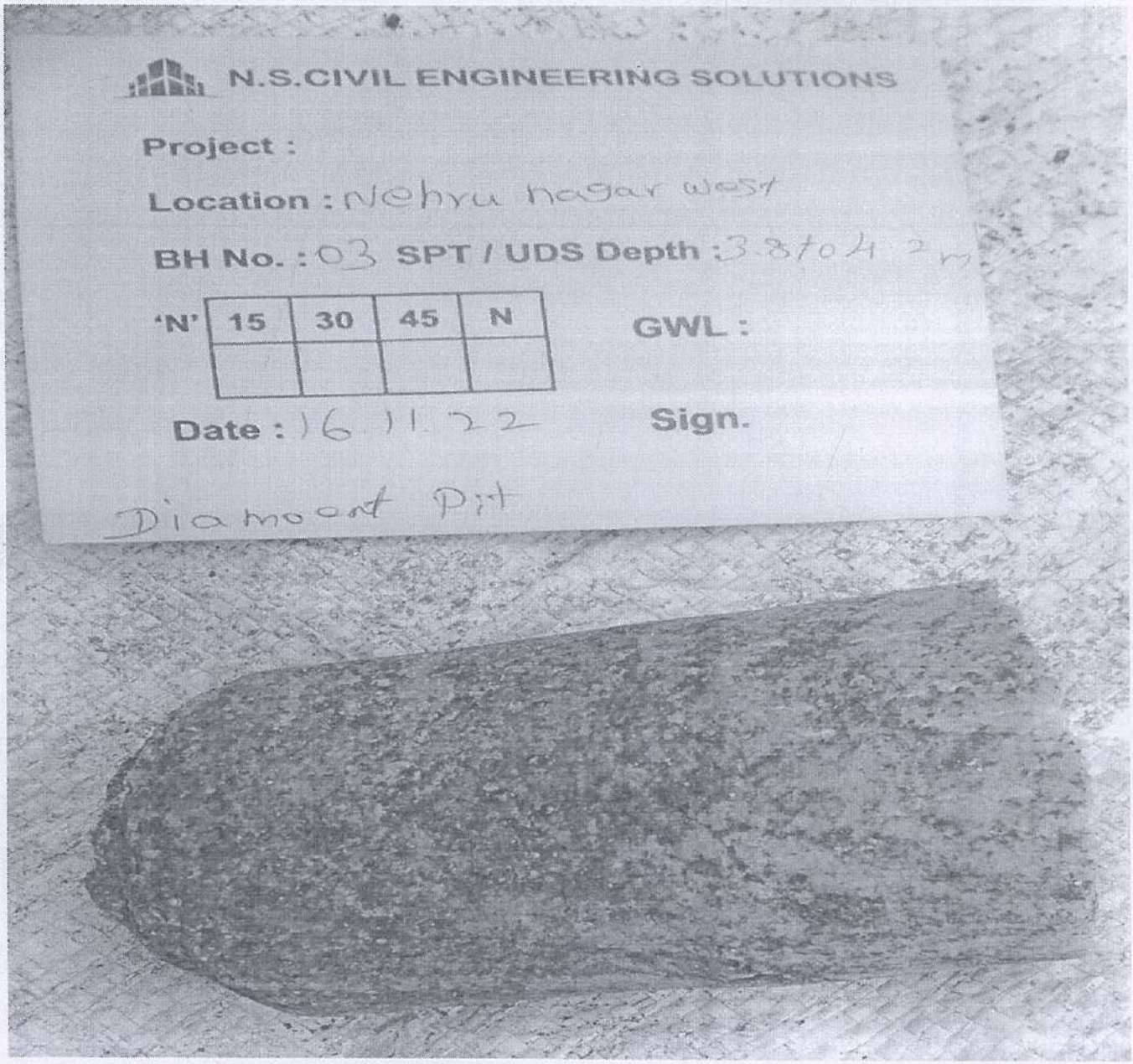
Diamond Pit



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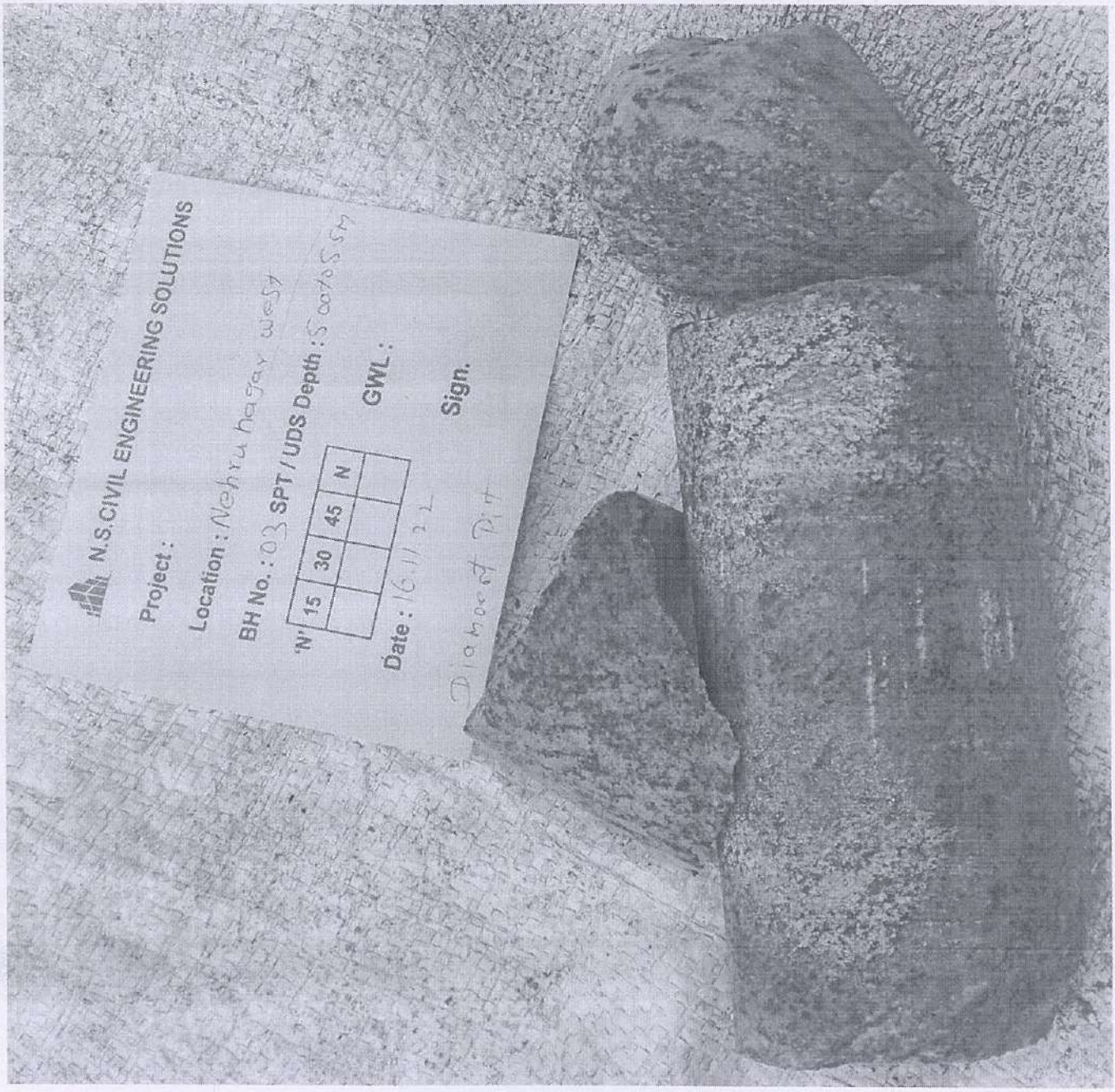
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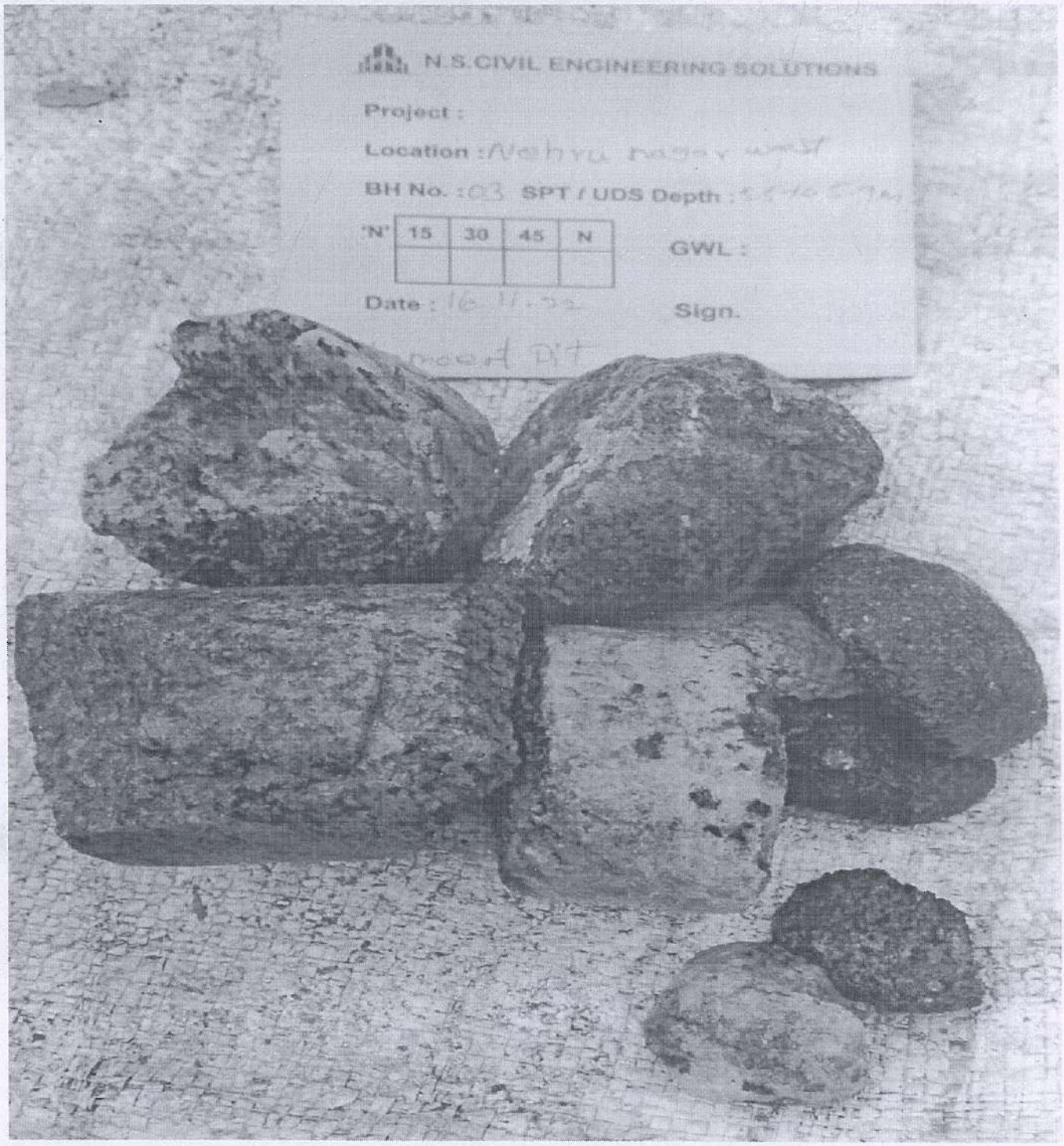
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