“**Gwarko** Overpass” A Learning Experience for DoR

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Date: 2081-01-21

Gwarko Overpass

Why Gwarko Overpass ?

- **For the management of high traffic congestion at Gwarko Chowk.**

- **For safe,reliable and easy traffic movement from Imadol – Mangalbazar Road section and Koteshor- Satdobato Road Section.**

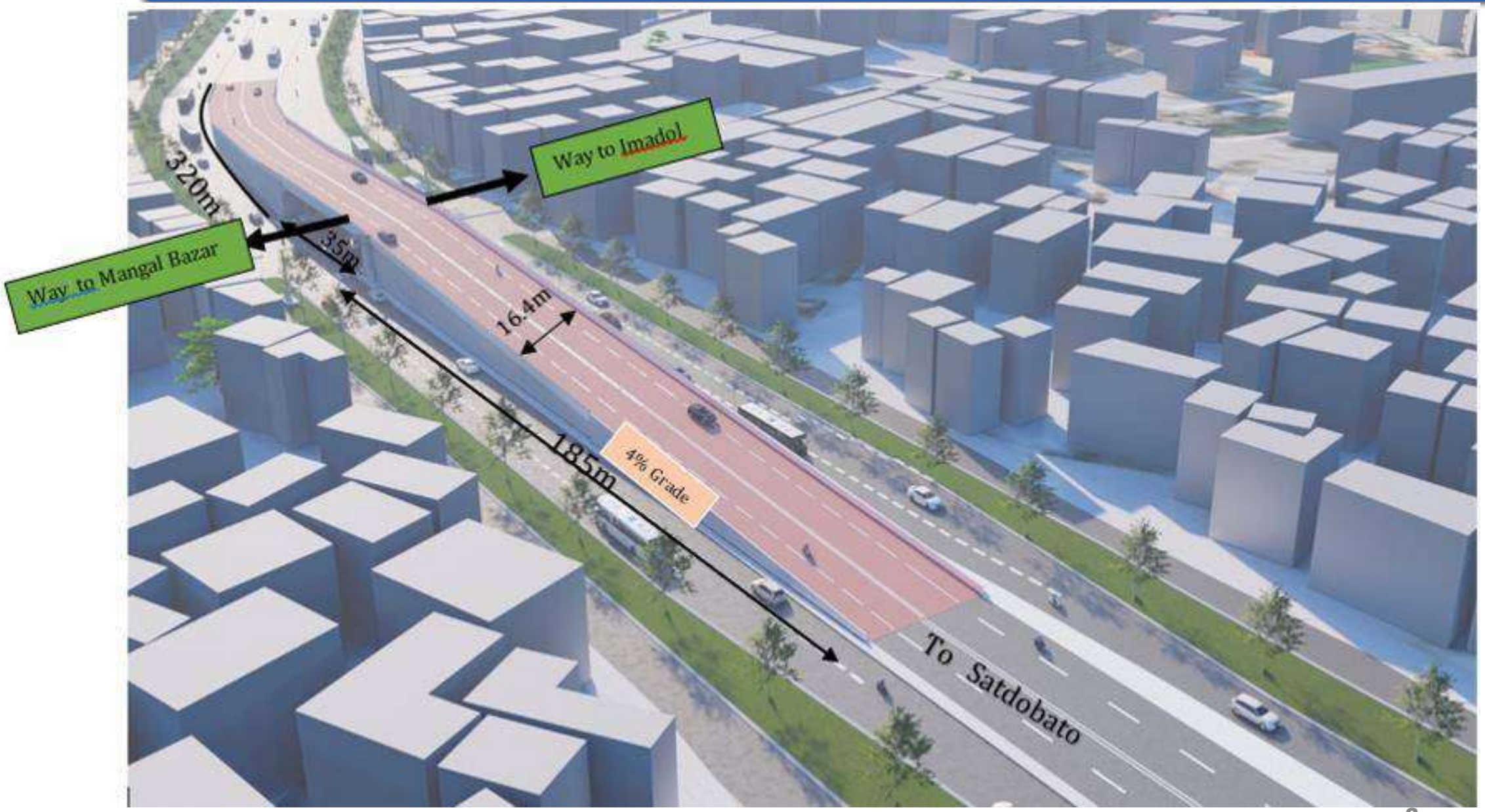
What are New things ?

- **Introduce of new Technologies as Full Depth Temporary Casing for Concrete Pile, Construction of Approach Road with Mechanically Stabilized Earthen wall etc.**

- Knowledge Sharing and Technology Transfer of New Technologies as mentioned above.

- Engineering Procurement and Construction (EPC) based Procurement

ग्वार्को Overpass निर्माण योजना



ग्वार्को फ्लाईवोभर निर्माण योजना

Contractor	Ashish-Samanantar-Religare JV
Date of Contract Agreement	10-Feb-2022(2078 Magh 27)
Date of Commencement	24-Feb-2022(2078 Falgun 12)
Completion Date	24-Feb-2024(2080-Falgun 11)
Contract Amount	NRs 170,688,888.01
Total length of Ramp and Bridge	185 m at left and 320 m at right side of bridge (540 m total ramp length) 36.2 m (total bridge length), Width of bridge=16.4m(4 Lane)
Min Vertical Clearance	6m
Contract Period	2 Years for construction + 5years DLP
Structure	Mechanically Stabilized Earth (MSE) wall
Components	Precast Panels, Geocore Connector, Geostraps
Panel detail	Precast Reinforced M35 Concrete Panels 160mm thick
Total type of panel	71
Total No. of panels required	2379

ग्वार्को फ्लाईवोभर निर्माण योजना

Structure	**Overpass Bridge**
Foundation	**M35 24 no. 1.2m dia 30m deep RCC Pile, Full depth Temporary casing,**
Sub structure	**M35 8 no. 1.5m dia 5.5m high RCC Pier**
Superstructure	**M45 7 no. 1.9m high 1.25m wide 36.2m long Precast Prestressed Post tensioning Girder**
Deck Slab	**220mm thick cast in situ slab**
Bearing	**Pot Bearing**
Median/ Barrier	**0.6m width New Jersey type median, 0.4m width crash barrier at edge**

ग्वार्को फ्लाईवोभर कार्यप्रगति

Construction of Overpass Bridge	Foundation: Completed Sub structure : Up to Pier cap completed at Satdobato side and Koteshwor side Girder : 7/7 Precast girder already casted and prestressed, 7/7 girders are already launched, preparing for cross girder and Deck Slab
Construction of Ramp	Gravel piles : 4102 nos completed. (2600/2600 nos completed in Koteshor side and 1502/1502 nos completed in Balkumari side) Erection of RE wall : 1200/2379 (50%) of RE panel already erected. Targeted to complete by end of Jestha 2081.
Traffic Management	Extension of Service lane, Road Marking at Gwarko chowk, Installation of traffic information board, Final design of traffic light/traffic management is ongoing
Overall Progress	Physical : 70% Financial : 10% (1 crore 37 lakh against Mobilization)

संपादन गरियका नयाँ र चुनौतीपूर्ण कार्यहरु

1.Pile Concreting with full depth Temporary Casing

2. Ground Improvement of Approach Road

3. RE panel casting and Erection

4. Precast Girder Launching

5. Traffic Management

6. EPC Contract Management

1. Pile Concreting with full depth Temporary Casing

Initial Design: 4 nos of 1.5 dia 34 m deep pile in each side

Problem: No availability of Equipment in India for inserting and removing temporary Casing of 1.5 dia and 34 m deep

Solution : Changed in Pile Design (1.2 m dia, 30 m deep 12 nos in each side) as per available capacity of Equipment for Temporary Casing. (It took almost 6 months to start the Pile work)

Arrival of Machines (Rig , Vibro hammer and 100MT Crane) and pile construction in Bhadra 22 2080

Testing of Concrete Pile

1. Pile Integrity Test: For Qualitative Evaluation of physical dimension, continuity and consistency of pile material.

Data Recording Unit

Hammering through Motion Transducer

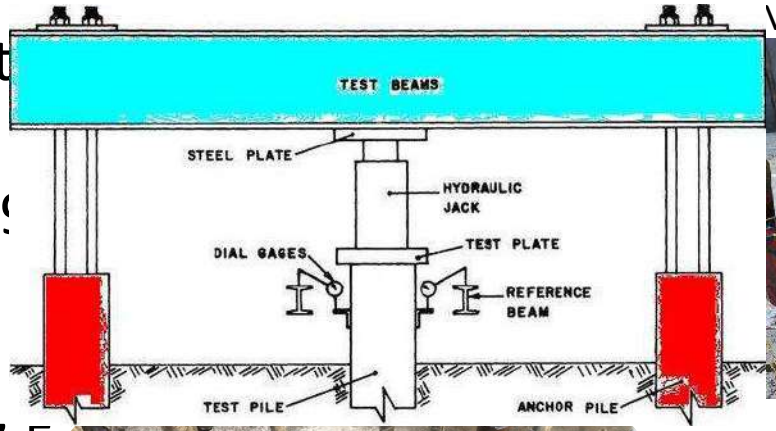
2. Static and dynamic Pile load Test: For Evaluat of load carrying capacity

For static : Given Load=1.5* working load= 291.

Pile capacity = 229.6t

Occurred settlement= 3mm<18mm OK

Dynamic for Test Pile : 2.5 * working Load = 487.5



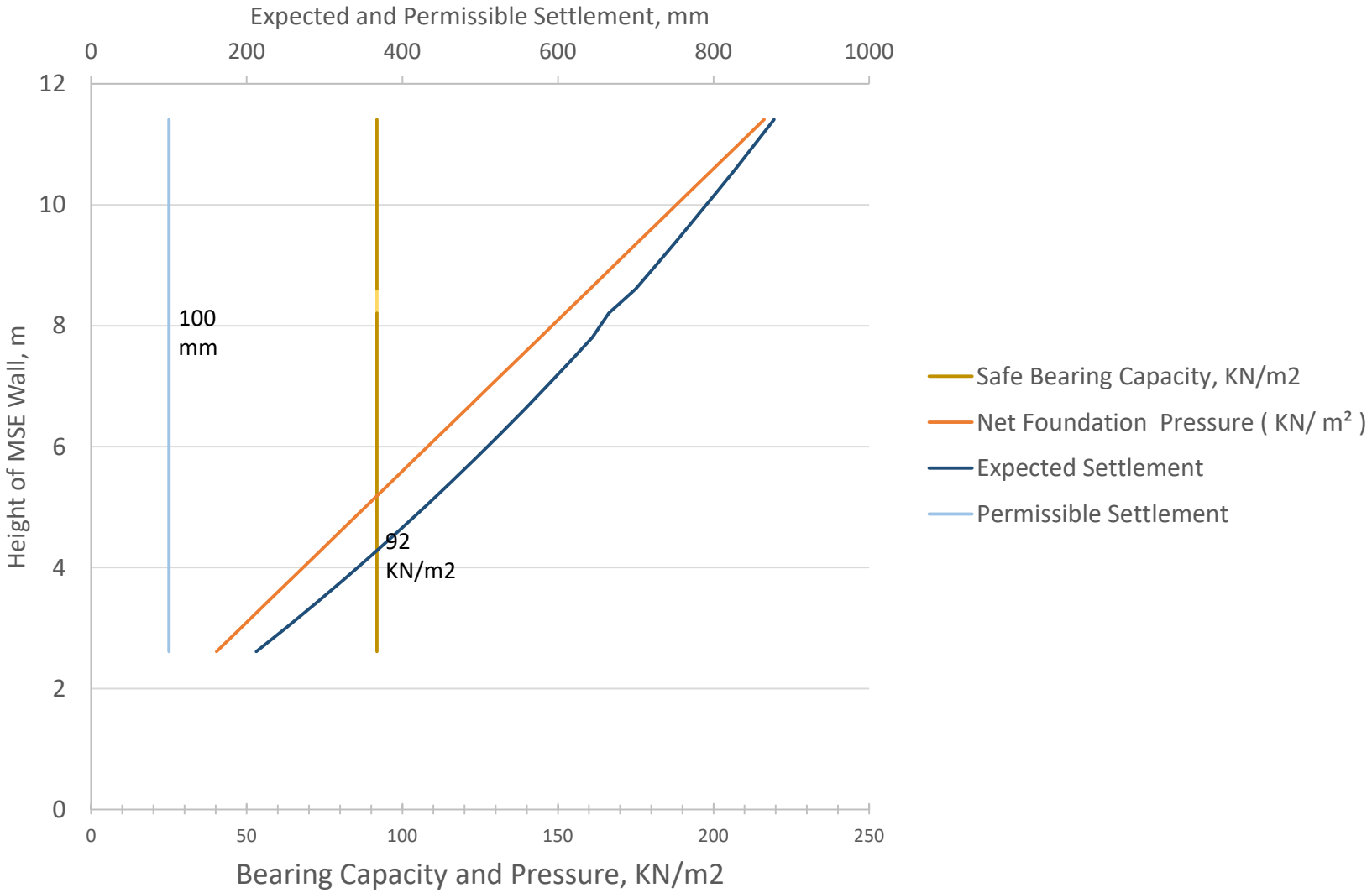
3. Sonic Tube : For Qualitative Evaluation of continuity and consistency of pile material.

Sonoc tube

observation

2. Ground Improvement of Approach Road

Bearing capacity of soil and settlement without Stone Column



Bearing Capacity of Existing Soil: 92 Kn/m2

Maximum Pressure of Embankment : 216 Kn/m2

Settlement ranges : 0.2 to 0.88m for different height of Embankment

Initial Provision: Prefabricated Vertical Drain (PVD) for solving settlement Problem but how bearing capacity?

Stone Columns Designed as per IS 15284(part 1):2003

Net Pressures, safe bearing capacity and settlements of different diameters and length of Stone Columns with increase of wall height

0.8m Diameter 10m long Stone Column in 1.5m spacing						
Wall Height, m	3.2	4.8	6.4	8	9.8	11.4
Pressure, KN/m^2	28.1	60.1	92.1	124.1	160.1	192.1
Bearing Capacity, KN/m^2	157.4	157.4	157.4	157.4	157.4	157.4
Settlement by Greenwood method, mm	39	76	108	136	165	187
Settlement by Priebe method, mm	34	67	96	121	146	166
0.7m Diameter 10m long Stone Column in 1.4m spacing						
Wall Height, m	3.2	4.8	6.4	8	9.6	10.2
Pressure, KN/m^2	28.1	60.1	92.1	124.1	156.1	168.1
Bearing Capacity, KN/m^2	144.2	144.2	144.2	144.2	144.2	144.2
Settlement by Greenwood method, mm	41	81	115	145	172	181
Settlement by Priebe method, mm	37	73	104	131	155	164
0.7m Diameter 9.5m long Stone Column in 1.4m spacing						
Wall Height, m	3.2	4.8	6.4	8	9.8	
Pressure, KN/m^2	28.1	60.1	92.1	124.1	160.1	
Bearing Capacity, KN/m^2	144.2	144.2	144.2	144.2	144.2	
Settlement by Greenwood method, mm	40	79	112	141	170	
Settlement by Priebe method, mm	36	71	101	127	153	
0.7m Diameter 9m long Stone Column in 1.4m spacing						
Wall Height, m	3.2	4.8	6.4	8	9.4	
Pressure, KN/m^2	28.1	60.1	92.1	124.1	152.1	
Bearing Capacity, KN/m^2	144.2	144.2	144.2	144.2	144.2	
Settlement by Greenwood method, mm	39	76	108	136	158	
Settlement by Priebe method, mm	35	69	98	123	143	

0.6m Diameter 8.5m long Stone Column in 1.3m spacing						
Wall Height, m	3.2	4.8	6.4	8	9	
Pressure, KN/m^2	28.1	60.1	92.1	124.1	144.1	
Bearing Capacity, KN/m^2	130.5	130.5	130.5	130.5	130.5	
Settlement by Greenwood method, mm	45	88	125	157	175	
Settlement by Priebe method, mm	40	79	111	140	156	
0.5m Diameter 8.5m long Stone Column in 1.3m spacing						
Wall Height, m	3.2	4.8	6.6			
Pressure, KN/m^2	28.1	60.1	96.1			
Bearing Capacity, KN/m^2	107.9	107.9	107.9			
Settlement by Greenwood method, mm	61	119	174			
Settlement by Priebe method, mm	50	98	144			
0.5m Diameter 8.0m long Stone Column in 1.3m spacing						
Wall Height, m	3.2	4.8	6.2			
Pressure, KN/m^2	28.1	60.1	88.1			
Bearing Capacity, KN/m^2	107.9	107.9	107.9			
Settlement by Greenwood method, mm	60	117	159			
Settlement by Priebe method, mm	50	97	132			
0.5m Diameter 7.5m long Stone Column in 1.3m spacing						
Wall Height, m	3.2	4.8	5.8			
Pressure, KN/m^2	28.1	60.1	80.1			
Bearing Capacity, KN/m^2	107.9	107.9	107.9			
Settlement by Greenwood method, mm	59	115	145			
Settlement by Priebe method, mm	49	95	120			
0.5m Diameter 7.0m long Stone Column in 1.3m spacing						
Wall Height, m	3.2	4.8	5.4			
Pressure, KN/m^2	28.1	60.1	72.1			
Bearing Capacity, KN/m^2	107.9	107.9	107.9			
Settlement by Greenwood method, mm	58	112	130			
Settlement by Priebe method, mm	48	93	108			

Gain of Bearing capacity and reduction of settlement due to consolidation by allowing about 2 weeks of time gap and 1.6m surcharge

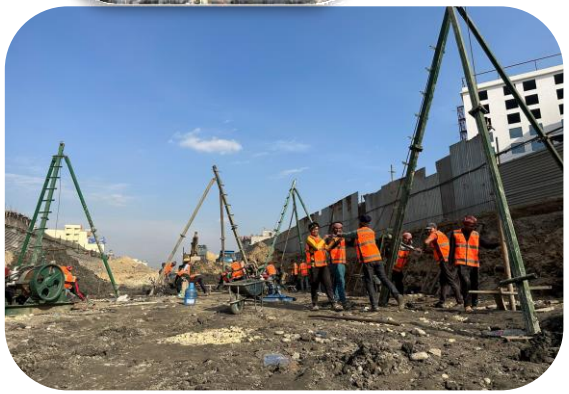
Description	Symbol	Unit	For 0.8m Diameter, 10m long stone columns with 1.5m spacing							Settlement for 10.2m height wall with 0.7m Diameter, 10m long stone columns with 1.4m spacing							Settlement for 9.8m height wall with 0.7m Diameter, 9.5m long stone columns with 1.4m spacing						Settlement for 9.4m height wall with 0.7m Diameter, 9m long stone columns with 1.4m spacing					
Total Wall Height	*H*	*m*	*0*	*3.2*	*4.8*	*6.4*	*8.0*	*9.6*	*11.4*	*0*	*3.2*	*4.8*	*6.4*	*8.0*	*9.6*	*10.2*	*0.0*	*3.2*	*4.8*	*6.4*	*8.0*	*9.8*	*0.0*	*3.2*	*4.8*	*6.4*	*8.0*	*9.4*
ital Net Stress in the foundation level	σ	KN/m^2	0	28.1	56	88	120	152	188.2	0	28.1	60.1	92.1	124.1	156.1	168.1	0	28.1	60.1	92.1	124.1	156.1	0	28.1	60.1	92.1	124	156
Overall gained safe bearing capacity of the column and unit cell	σ_{safe}	KN/m^2	157	157	157	157	183	183	208	144	144	144	144	168	168	168	144	144	144	144	168	168	144	144	144	144	168	168
Consolidation settlement of composit (treated) soil due to Stone Column Greenwood	$\Delta H'_C$	mm		39	76	108	39	68	29		41	81	115	41	68	77		40	79	112	40	69		39	76	108	39	61
Consolidation settlement of composit (treated) soil due to Stage construction	$\Delta H'_{CStage}$	mm				97		61					103							101						97		
Remaining settlement within the length of Stone Column after staged construction	$\Delta H'_{Stage}$	mm		39	76	11	39	7	29		41	81	11	41	68	77		41	79	11	40	69		41	76	11	39	61
Consolidation settlement of composit (treated) soil due to Stone Column Priebe	$\Delta H'_C$	mm		32	62	87	34	59	26		37	73	104	37	61	70		36	71	101	36	62		35	69	98	35	55
Consolidation settlement of composit (treated) soil due to Stage construction	$\Delta H'_{CStage}$	mm				78		53					93							91						88.2		
Remaining settlement within the length of Stone Column after staged construction	$\Delta H'_{Stage}$	mm		32	62	9	34	6	26		37	73	10	37	61	70		36	71	10	36	62		37	69	10	35	55
rmissible settlement		mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Description	Symbol	Unit	Settlement for 9.0m height wall with 0.6m Diameter, 8.5m long stone columns with 1.3m spacing						Settlement for 6.6m height wall with 0.5m Diameter, 8.5m long stone columns with 1.3m spacing				Settlement for 6.2m height wall with 0.5m Diameter, 8.0m long stone columns with 1.3m spacing				Settlement for 5.8m height wall with 0.5m Diameter, 7.5m long stone columns with 1.3m spacing				Settlement for 5.4m height wall with 0.5m Diameter, 7.0m long stone columns with 1.3m spacing							
Total Wall Height	*H*	*m*	*0*	*3.2*	*4.8*	*6.4*	*8.0*	*9.0*	*0*	*3.2*	*4.8*	*6.6*	*0.0*	*3.2*	*4.8*	*6.2*	*0.0*	*3.2*	*4.8*	*5.8*	*0.0*	*3.2*	*4.8*	*5.4*				
ital Net Stress in the foundation level	σ	KN/m^2	0	28.1	60	92	124	156	0	28	60	92	0	28	60	92	0	28	60	92	0	28	60	92				
Overall gained safe bearing capacity of the column and unit cell	σ_{safe}	KN/m^2	131	131	131	131	152	174	108	108	108	126	108	108	108	126	108	108	108	126	108	108	108	126				
Consolidation settlement of composit (treated) soil due to Stone Column Greenwood	$\Delta H'_C$	mm		45	88	125	43	22		61	119	67		60	117	54		59	115	42		61	119	67				
Consolidation settlement of composit (treated) soil due to Stage construction Greenwood	$\Delta H'_{CStage}$	mm				114	39				107				105				104				107					
Remaining settlement within the length of Stone Column after staged construction Greenwood	$\Delta H'_{Stage}$	mm		45	88	11	4	22		61	12	67		60	12	54		59	12	42		61	12	67				
Consolidation settlement of composit (treated) soil due to Stone Column Priebe	$\Delta H'_C$	mm		40	79	111	39	20		50	98	56		50	97	45		49	95	35		50	98	56				
Consolidation settlement of composit (treated) soil due to Stage construction Priebe	$\Delta H'_{CStage}$	mm				101	36				88				87				86				88					
Remaining settlement within the length of Stone Column after staged construction Priebe	$\Delta H'_{Stage}$	mm		40	79	10	4	20		50	10	56		50	10	45		49	10	35		50	10	56				
rmissible settlement		mm	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100				

2. Ground Improvement of Approach Road (Total 4102 nos of Stone Column casted)

Click forNEA\IMG_2310.MOV video

Diameter	Spacing	Embankment height
0.8m	1.5m	10.6 to 11.4
0.7m	1.4m	9.4 to 10.2
0.6m	1.3m	7.0 to 9.0
0.5m	1.2m	5.4 to 6.6



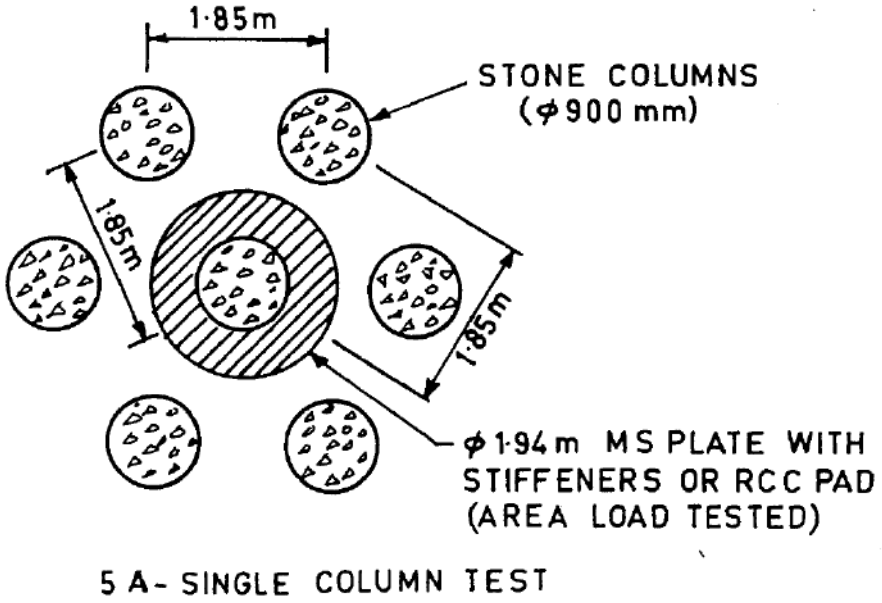
Boring Work

Borehole

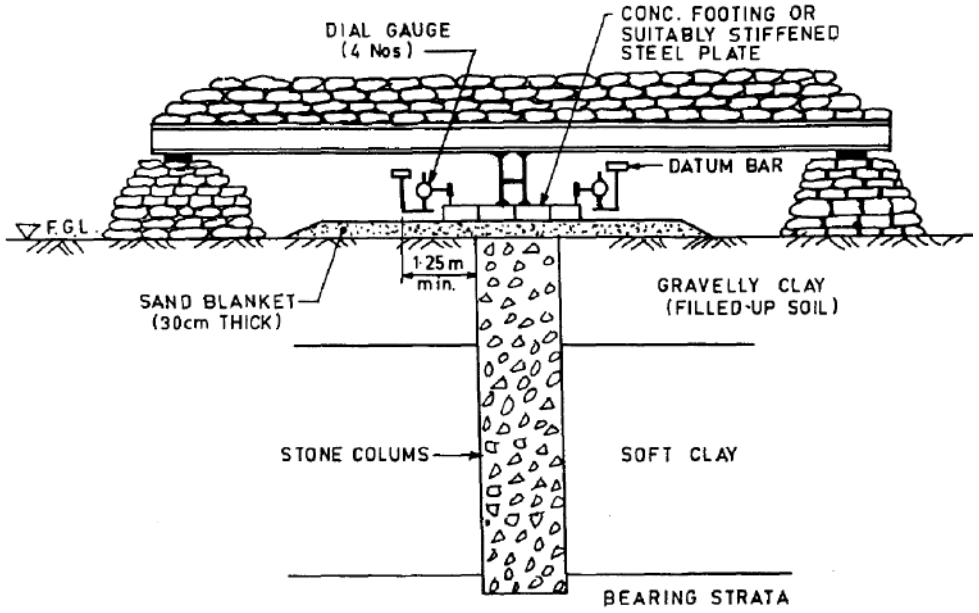
Gravel Pouring

Gravel Compaction

Verification of Ground Improvement by Plate Load Test (As IS 15284 (Part 1): 2003)



5 A- SINGLE COLUMN TEST



Verification of Ground Improvement by Plate Load Test (IS 15284 (Part 1): 2003)

Without Stone Column, Settlement> 10 mm after 150 KN load

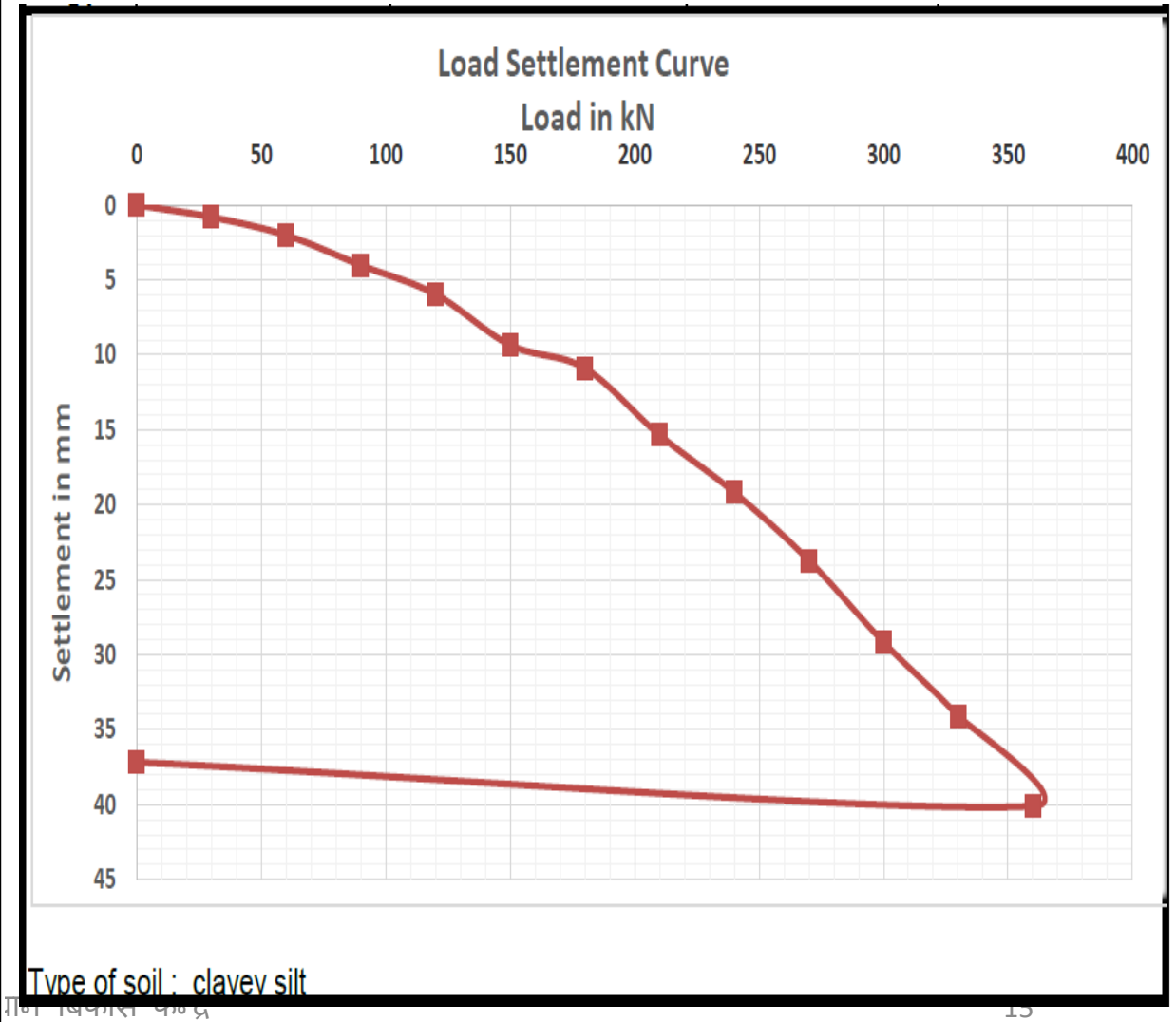
MULTI LAB (P) LTD

Stone Column Test -2 as per IS - 15284

Load Settelment Curve-Natural Ground

Project	:	Fly Over Bridge and Road project
Location	:	Gwarko, Lalitpur
Client	:	QRDC/DOR
Contractor	:	Sammanantar-Ashish-Religare-JV
RCC Pad Thickness	:	37cm
Diameter of RCC Pad	:	1.365
No. of Plate/Size Uses	:	**3 Plates (1.0m, 60 cm, 45cm)**
Stone Column Size/Depth	:	Natural Ground-2m below
Dial Guages Least Count mm	:	0.01
Loading Mechanism	:	Kentldge
Max Target Load, KN	:	193.6
Max Test Load , KN	:	270
Date	:	14th Feb 2024 to 15th Feb 2024

S No	Load	Settlement	Total Settlement	Remarks
	kN	mm	mm	
1	0	0	0	
2	30	0.81	0.81	
3	60	1.21	2.02	
4	90	2.00	4.02	
5	120	1.94	5.96	
6	150	3.39	9.35	
7	180	1.55	10.90	
8	210	4.46	15.36	
9	240	3.82	19.18	
10	270	4.55	23.73	
11	300	5.46	29.19	
12	330	4.94	34.13	
13	360	6.00	40.13	
14	0	-2.94	37.19	



Type of soil : clayey silt

Verification of Ground Improvement by Plate Load Test (As IS 15284 (Part 1): 2003)

In 0.8m Diameter Single Stone Column: Max Working Load=421KN for 11.4m Embankment height,

Settlement = 8mm < 10mm OK.

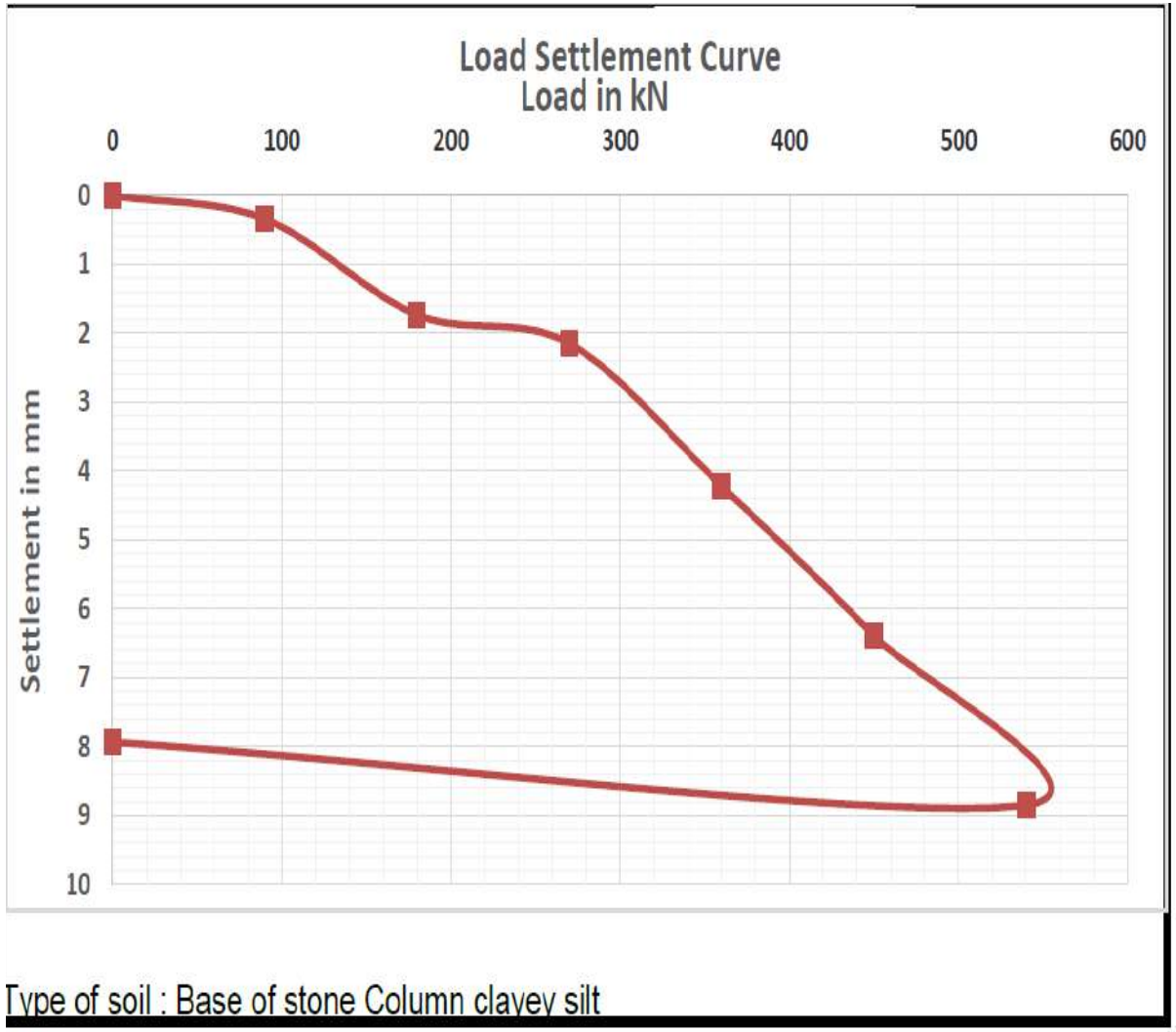
MULTI LAB (P) LTD

Stone Column Test -4 as per IS - 15284

Load Settelment Curve

Project	:	Fly Over Bridge and Road project
Location	:	Gwarko, Lalitpur
Client	:	QRDC/DOR
Contractor	:	Sammanantar-Ashish-Religare-JV
RCC Pad Thickness	:	37cm
Diameter of RCC Pad	:	1.575
No. of Plate/Size Uses	:	**3 Plates (1.0m, 60 cm, 45cm)**
Stone Column Size/Depth	:	700 mm/10m(9.5m)
Dial Guages Least Count mm	:	0.01
Loading Mechanism	:	Kentldge
Max Target Load, KN	:	463.3
Max Test Load , KN	:	540
Date	:	27th Feb 2024 to 28th Feb 2024

S No	Load	Settlement	Total Settlement	Remarks
	kN	mm	mm	
1	0	0	0	
2	90	0.343	0.343	
3	180	1.390	1.733	
4	270	0.417	2.150	
5	360	2.068	4.218	
6	450	2.175	6.393	
7	540	2.455	8.848	
8	0	-0.915	7.933	



Type of soil : Base of stone Column clayey silt

Verification of Ground Improvement by Plate Load Test (As IS 15284 (Part 1): 2003)

In 0.7m Diameter Single Stone Column: Max Working Load=299KN to 326KN Upto 9.4m to 10.2m height

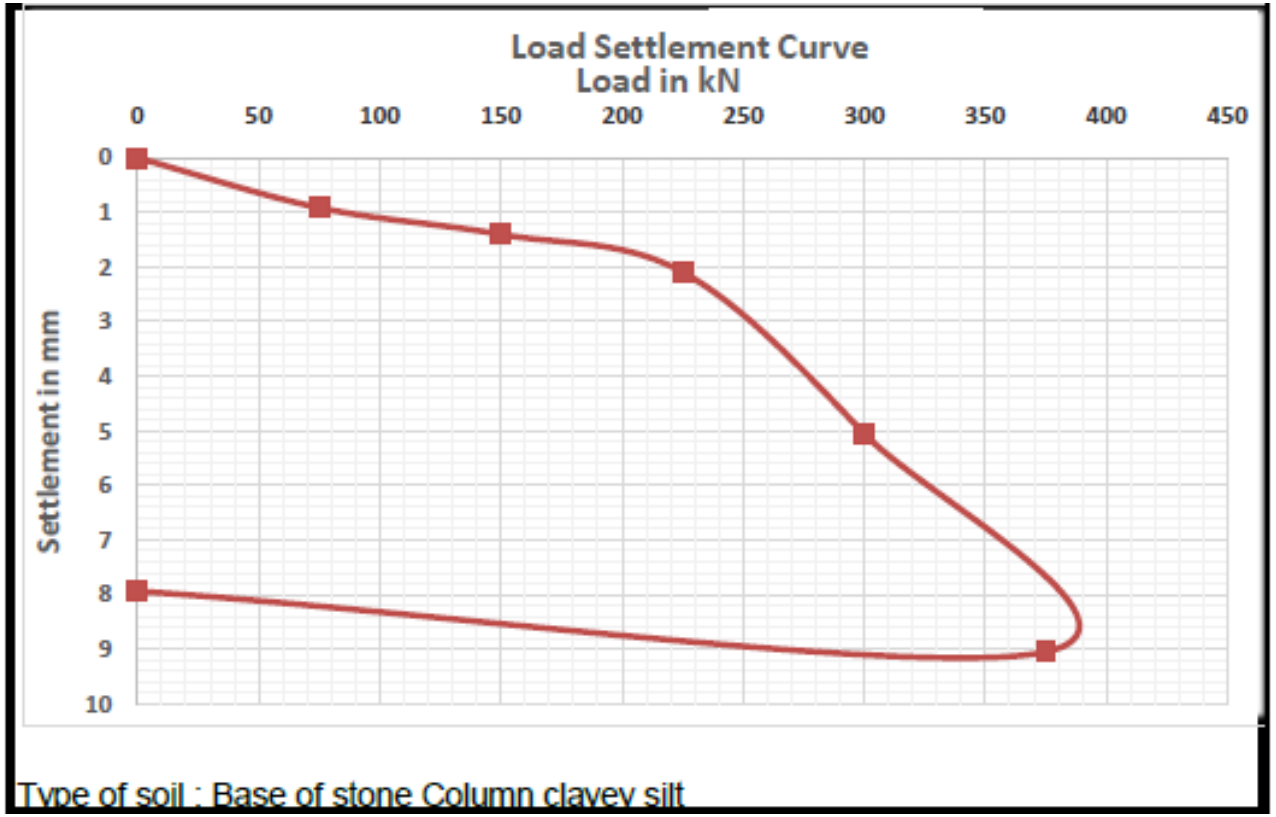
MULTI LAB (P) LTD

Stone Column Test -1 as per IS - 15284

Load Settelment Curve

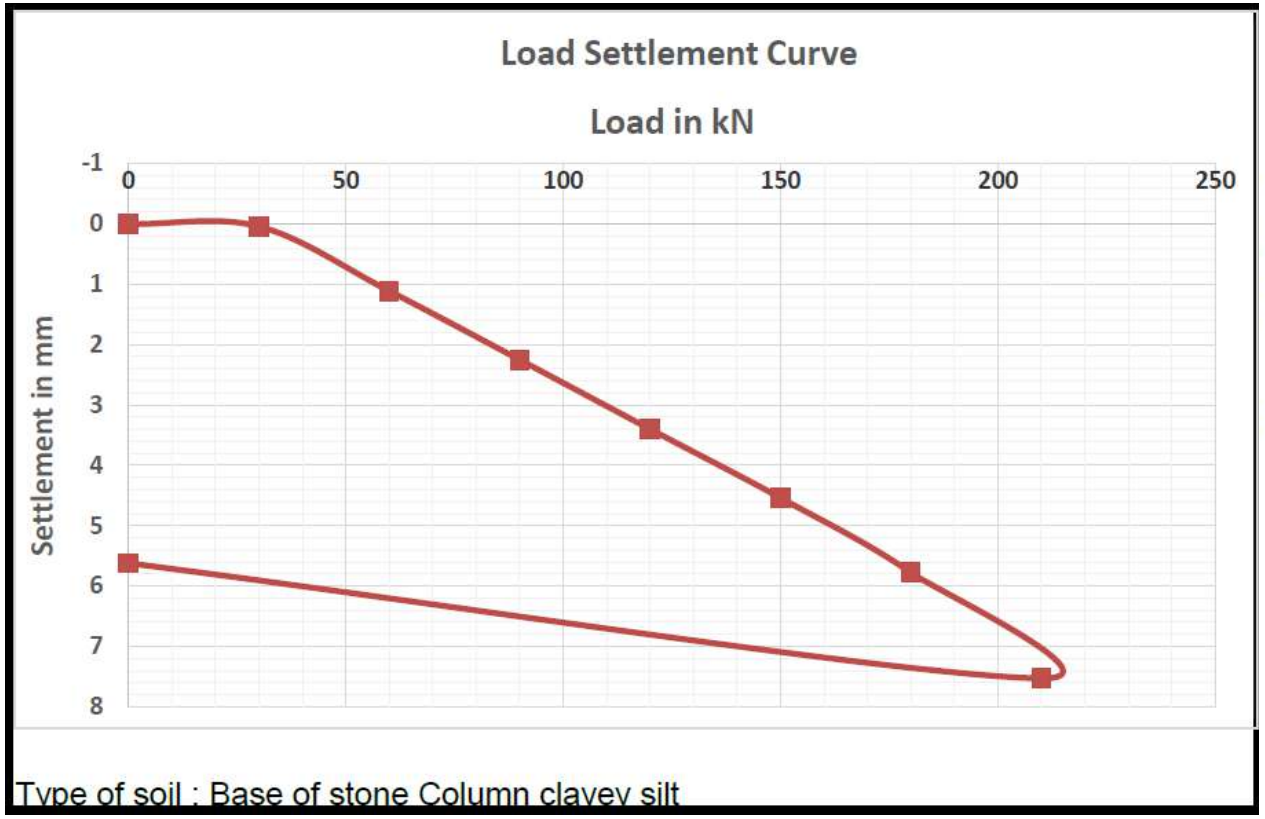
Project	:	Fly Over Bridge and Road project
Location	:	Gwarko, Lalitpur
Client	:	QRDC/DOR
Contractor	:	Sammanantar-Ashish-Religare-JV
RCC Pad Thickness	:	37cm
Diameter of RCC Pad	:	1.47
No. of Plate/Size Uses	:	**3 Plates (1.0m, 60 cm, 45cm)**
Stone Column Size/Depth	:	700 mm/10m(9.5m)
Dial Guages Least Count mm	:	0.01
Loading Mechanism	:	Kentldge
Max Target Load, KN	:	358.8
Max Test Load , KN	:	375
Date	:	20th Feb 2024 to 21st Feb 2024

S No	Load	Settlement	Total Settlement	Remarks
	kN	mm	mm	
1	0	0	0	
2	75	0.913	0.913	
3	150	0.488	1.401	
4	225	0.690	2.091	
5	300	2.958	5.049	
6	375	4.000	9.049	
7	0	-1.110	7.939	



Verification of Ground Improvement by Plate Load Test (As IS 15284 (Part 1): 2003)

In 0.5m Diameter Single Stone Column



MULTI LAB (P) LTD

Stone Column Test -1 as per IS - 15284

Load Settelment Curve

Project	:	Fly Over Bridge and Road project
Location	:	Gwarko, Lalitpur
Client	:	QRDC/DOR
Contractor	:	Sanmanantar-Ashish-Religare-JV
RCC Pad Thickness	:	37cm
Diameter of RCC Pad	:	1.365
No. of Plate/Size Uses	:	**3 Plates (1.0m, 60 cm, 45cm)**
Stone Column Size/Depth	:	500 mm/ 8.5m
Dial Guages Least Count mm	:	0.01
Loading Mechanism	:	Kentldge
Max Target Load, KN	:	193.6
Max Test Load , KN	:	210
Date	:	12th Feb 2024 to 13th Feb 2024

S No	Load	Settlement	Total Settlement	Remarks
	kN	mm	mm	
1	0	0	0	
2	30	0.040	0.040	
3	60	1.070	1.110	
4	90	1.140	2.250	
5	120	1.150	3.400	
6	150	1.140	4.540	
7	180	1.240	5.780	
8	210	1.750	7.530	
9	0	-1.908	5.622	

3. RE Panel Casting and Erection

Basic Requirements:

- Soil- Granular Material
- Reinforcements
- Facing Unit

Granular Material

Geostrap as Reinforcment

Facing Unit

3. RE Panel Casting and Erection

Components of RE Wall:

- Facing Unit- PreCast Panel (M35)
- Mechanical Connection- GeoCore
- Non-Woven GeoTextiles as separator
- EPDM PAD- horizontal joints
- Drainage System- DrainTube

GeoCore

Drain Tube

Precast Panel

Geo Textile

3. RE Panel Casting and Erection

Equipment and Machineries

- 14 Ton- Hydra- for lifting & Erection of Panels
- Truck- bringing of RE fill & Shifting the Panels
- 10MT & 1MT vibratory compactor- For compaction
- Grader & JCB- For spreading the Re fill at bed
- FDD test equipment- For compaction test at site
- Water Tanker- For curing & sprinkling for compaction at site

3. RE Panel Casting and Erection

Erection Procedure

- Arrangements of Equipment & Machineries
- Casting of Panels as per drawings
- Curing of Panels for 14 days
- Excavation as per design level
- Checking of foundation strata- whether ground improvement needed or not
- Removing of Black Soil from foundation
- Casting of Level pad
- Installation of Panels
- Alignment & Slope fixing of Panels
- Fixing of Soil Reinforcement
- Filling and compaction of RE Fill
- Fixing of Drainage system

4. Precast Girder casting and Launching

Concreting

सार्वजनिक सूचना

गुणस्तर अनुसन्धान तथा विकास केन्द्रको Gwarko Flyover Site अन्तर्गत Girder Launching गर्दा सडक प्रयोगकर्ताहरूलाई हुन सक्ने जोखिमलाई मध्यनजर गर्दै जिल्ला प्रशासन कार्यालय ललितपुरको मिति २०८०/१२/३० गतेको निर्णयानुसार २०८१/०१/०६ देखि २०८१/०१/११ गते बेलुका १०:०० देखि बिहान ४:०० बजेसम्म सातदोबाटो देखि बालकुमारी पुलसम्म पैदलयात्रु आवतजावत तथा यातायात संचालन पूर्ण रुपमा बन्द हुने गरेकोले सर्वसाधारण सबैको जानकारीका लागि यो सूचना जारी गरिएको छ । यसबाट पर्न गएको असुविधा प्रति गुणस्तर अनुसन्धान तथा विकास केन्द्र क्षमाप्रार्थी छ ।

नेपाल सरकार
भौतिक पूर्वाधार तथा यातायात मन्त्रालय
सडक विभाग
गुणस्तर अनुसन्धान तथा विकास केन्द्र

Notice for road Closure

Crane for Lifting

Carrying Girder

Lifting Girder

Launched Girders

5. Traffic Management

Traffic Mangement

Traffic Information

Barricading the site

Road Marking for Traffic Management

Information Board at Ekantakuna/Jadibuti

Traffic Control Devices Handover to Police

Challenges and Way Forward

Traffic Management	Coordination with Traffic Office, Road Marking Paint, Widening pavement, Information broadcasting in media, Barricading, Coordination with DAO and other stakeholder
Working Space for Equipment	Use of available space for huge Equipment
Ground Improvement for Ramp	Because of unforeseen conditions of the soil characteristic, Design has been revised continuously. Provision of PVD was replaced by Stone Columns.
Timely Completion and EOT	Though Contractor has committed to complete the Project timely it could not happened because of necessity of stone column casting. And frequently changes in soil type from place to place.

Challenges and Way Forward

EPC Contract

-New for Employer and the Contractor.

-Principally, the risk of design and construction shall be of the Contractor but in this case design and drawings have to be approved by the Employer.

- As per Fidic, EPC shall not be used for underground works and other works where there are unforeseeable , but we have used in Tunnel Project also. It makes dispute during construction.

- Estimate for the EPC contract should be in budget ceiling not in detail as BOQ .
- Mentioning detail specification in Employer's Requirement restricts innovation in the design and construction procedure, thereby, shifting risks back to the employer, it shall be to the level of functional requirements,
- Needs update of EPC bidding Document


KNOWLEDGE SHARING AND TECHNOLOGY TRANSFER
ON
Pile Integrity Test (PIT) & Pile Load Test (PLT)
Name of the Employer:
Department of Road
Quality Research and Development Center, Chakupat, Lalitpur

Thank you