APPENDICES

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Appendix 1 Interim Working Group Meeting

APPENDIX 1 INTERIM WORKING GROUP MEETING

1.1 Objectives

To wrap up the first mission, Interim Working Group (WG) meeting was conducted on February 11th, 2019 to present general findings and discuss the directions for short-term, mid.-term, and long-term based on the findings.

1.2 Overview of the Working Group Meeting

1.2.1 Time and Venue

The meeting was held at a Meeting Room of Ministry of Physical Infrastructure and Transport on February 11, 2019, 14:00 -16:15.

1.2.2 Participants

Working Group Members

- Mr. Gopal Prasad Sigdel, Joint-Secretary, MOPIT [Chairperson]
- Mr. Ajay Kumar Mull, Under Secretary, MOPIT
- Mr. Prakash Poudel, Engineer, MOPIT
- Mr. Gokarna Pd. Upadhyay, Director, MOPIT-DOTM
- Mr. Yek Raj Adhikari , Senior Divisional Engineer, MOUD
- Mr. Bhagawat B. Khokhali, Urban Planner, Kathmandu Valley Development Authority (KVDA)
- Mr. Padam B. Bista, DY. S.P., Metropolitan Traffic Division (MPTD), Ramshahpath Division
- Mr. Ram Thapa, Director, Kathmandu Metropolitan City

JICA Nepal Office

- Mr. Naoki NISHIMURA
- Mr. Sourab Rana

JICA Survey Team

- Mr. Yoshihisa ASADA, Team Leader / Urban Transport Planning
- Mr. Yoshiya NAKAGAWA, Deputy Team Leader / Public Transport Planning
- Mr. Yoshiki MIYAZAKI, Road Planning
- Mr. Koichiro OHARU, Civil Structural Design (Raod) / Construction & Procurement Plan
- Mr. Hideo SHIRAISHI, Project Management / Transport Model / Invitation Program

1.2.3 Meeting Materials

The agenda, the minutes, and some photos from the meeting are in the following pages.

AGENDA

Interim Working Group

for the Data Collection Survey on Urban Transport in Kathmandu Valley

by JICA SURVEY TEAM

Date & Time: 11th Feb, Monday, 2pm-4pm

Place: MOPIT Meeting Room

1. Opening remark / MOPIT & JICA Nepal Office
2. Outline of the survey /Team Leader (Asada)
3. General Finding, Present Issues on KV Urban Transport Sector / Dep TL (Nakagawa)
   - Private companies' initiatives in KV transport market
   - Decentralization and three levels of governance structure in KV
   - Masterplan vs Supply side offers
   - Road network insufficiency and Eastern region development, etc
4. Medium term (intersection improvement) team / Road Experts (Oharu/Miyazaki)
   - Assessment of present conditions and future conditions,
   - Target intersections and engineering considerations
   - Options for further improvement
5. Short-term (Traffic management/Public transport) / (Nakagawa)
   - Possibility of TA package, scope, scheme and background
   - Expected goal, approaches (geometric improvement and Signal light installations)
   - Other SDG packages for EV promotions
6. Long-term (Urban Railway System) / (Asada)
   - Present railway proposals, possible further approaches
7. Further action / (Asada)
8. Discussion
9. Closing remark / MOPIT

Note: The final working group are to be expected on 12 April (Friday) in the morning period.

Minutes

of

Interim Working Group Meeting

for

Data Collection Survey

on

Urban Transport Sector

in

Kathmandu Valley

Kathmandu, February 19th2019

Er. Gopal Prasad Sigdel
Joint Secretary
Ministry of Physical Infrastructure
and Transport

Mr. Yoshihisa ASADA
Team Leader
JICA Study Team

The Interim Working Group Meeting(hereinafter referred to as "the WG")for "Data Collection Survey on Urban Transport in Kathmandu Valley" (hereinafter referred to as "the Survey") was held on February 11th 2019 based on the invitation letter sent from Mr. Ajay Kumar Mull, Senior Division Engineer of Ministry of Physical Infrastructure and Transport (hereinafter referred to as "MOPIT"). The meeting was chaired by Er. Gopal Prasad Sigdel, Joint Secretary of MOPIT.List of attendees is attached as Annex 1.

In the welcome speech, the Chairperson echoed the agenda of the WGand asked Team Leader of the Survey, Mr. Asada (JICA Study Team), to present the progress of the Survey in accordance with the agenda. The presentation material was distributed to all attendees. The meeting with the agenda is summarized as below.

14:00~14:05	Opening Remarks:Chairperson
14:05~14:10	Presentation on Outline of the Study:Mr. Asada (Team Leader, JICA Study Team)
14:10~14:25	Presentation on General Findings and Present Issues:Mr. Nakagawa (Deputy Team Leader, JICA Study Team)
14:25~15:00	Presentation on Medium-Term project:Mr. Oharu (Civil Structure Design (Road)/ Procurement and Construction Plan Expert, JICA Study Team)
15:00~15:15	Presentation on Traffic Management and Public Transport project:Mr. Nakagawa
15:15~15:30	Presentation on Long-Term project, Further Steps:Mr. Asada
15:30~16:10	Discussion
16:10~16:15	Closing Remarks: Mr. Nishimura (JICA Nepal Office)

Comments and Inputs to the Study Team

After the presentation, the Chairperson proceeded into a question and answer session. The main points of discussion in the WGare summarized as following:

Comment on the difference of construction method between flyover and underpass

- Mr. Nishimura, Representative of JICA Nepal Office, asked a question to confirm shorter construction period between flyover and underpass.
  - Mr. Oharu, Civil Structure Design (Road)/ Procurement and Construction Plan Expert, JICA Study Team, replied that construction period of flyover is shorter than that of underpass in general, however, underpass construction method of open-cut tunnel without any road deck panels, which requires enough space of roads for traffic at both side, may require shorter period. Considering the proposed site with heavy traffic section, road decking panels are necessary for its construction. Therefore, construction period of underpass will be longer than that of flyover for this project.
  - Mr. Miyazaki, Road Planning Expert, JICA Study Team, added his answers that construction period of flyover is roughly estimated to be around 24 ~ 30 months. The construction period of underpass is basically affected by the number of separate stages of construction usingconstruction materials such as steel pile and road decking panel, and it may require around 3 ~ 4 years, which is around 1.5 times longer than that of flyover.

Comment to Nepali Government for applying JICA's assistance schemes

- Mr. Nishimura, Representative of JICA Nepal Office, stated his understanding of the project, that is, traffic congestion at Tinkune–Koteshower intersections cannot be solved without installing long-term railway project.He also mentioned his expectation that Nepali Government will built the consensus among stakeholders on the necessity of urban railway system for their future urban transport system.
- No one from attendees made any objections to his comments.

Questions on the short-term project (traffic management)

- Mr. Nishimura, Representative of JICA Nepal Office, asked concrete idea to improve transport management plan at Old Baneshwor intersection.
  - Mr. Asada, Team Leader, JICA Study Team, suggested managing staggered intersections as one intersection if physical improvement is not applicable to thoseintersections.He also recommended the pilot project at the intersection to seek for an optimized solution among several technical countermeasures on transport management.
- Mr. Thapa, Director, Kathmandu Metropolitan City, asked if target intersections are set on only three intersections (Maitighar, New and Old Baneshwor) whereas there are lots of small-scale intersections which also need to be improved.
  - Mr. Nakagawa, Deputy Team Leader, JICA Study Team, explained that those three intersections are selected as examples and emphasized the importance of enriching contents of Technical Assistance including target intersections with Nepali Government who have detailed traffic situation.

Question on the long-term project (urban railway system)

- Mr. Khokhali, Urban Planner, KVDA, recognized that estimated population in Eastern area of Kathmandu Valley is appropriate in line with the population growth of the Valley which was doubled in the past seven years. He also stated some comments on urban railway system, which are summarized below.
  - Concept of urban railway system is excellent to accommodate large amount of population growth in the Eastern area which are planned by KVDA currently.
  - He is interested in willingness to pay of the passengers for the urban railway system. He also mentioned that the JICA Study Team needs to confirm if outer ring road is included in the transport model. KVDA assumes that current population density is high in the Western and Northern parts of Kathmandu Valley whereas that of Eastern and Southern parts will be dense in the future, which will be connected by outer ring road including four municipalities.
  - He also mentioned the importance of integrating plans ofurban railway route (North-route) and outer ring road which are intersected each other.
  - He offered to make further discussion on the urban railway project to incorporate location of railway stations into their development plan of the Eastern region, which will be prepared within six months.
  - Expressway between Kathmandu and Taraiby tunnel will be extended up to outer ring road. It is recommended to include its impact on urban roads.
- Mr. Asada responded to Mr. Khokhali'squestions, which are summarized below;
  - Outer ring road is included in the transport model developed in JICA STRADA. He also mentioned that this model was initially developed in previous JICA Urban Transport Master Plan Study and updated by KSUTP implemented by ADB for their analysis on urban railway network prioritization.
  - In the North route, current location of urban railway station is proposed near the alignmentof outer ring road. It is appreciated to have further discussion on this matter in the meeting with KVDA which will be held tomorrow.

Comments on the medium-term project (intersection improvement)

- Mr. Khokhali, Urban Planner, KVDA, stated his comments on road network, which are summarized below;

- Under the current road network, which has limited access to the city center passing only Arniko highway, cannot solve traffic congestion at Tinkune - Koteshower intersections. Therefore, it is recommended to enhance other road networks.
- River corridor is planned to be expanded to two lanes (9 meters) per direction in the future.
- There might be an alternative route for detour or shortcut to Koteshowor intersection around airport boundary, which is more inside of Monahara river corridor.
- There may be necessary to consolidate parallel road to the Northern side of Arniko highway.

- Mr. Sourab, Senior Program Manager, JICA Nepal Office, also asked whether New Baneshwor intersection requires the grade-separation.
  - Mr. Asada answered that, transport demand forecast and intersection traffic flow analysis results to manage future traffic demand under current number of lanes including side roads by signal control, however,the gradeseparationwould be preferable if the urban railway station and public transport exchange facilities needs to be coordinated.

Consensus among attendees

- As described in the last page of the presentation, Mr. Asada requested attendees to confirm the further actions, as well as pre-condition and assumptions for the Study. All of attendee suggested their positive consensus on following items:
  - Future socio-economic framework is set based on 2030 scenario developed in KSUTP.
  - Further consideration of medium-term project (intersection improvement) will be implemented covering entire section of Tinkune -Koteshower intersections. It also takes installation of urban railway system and bus terminal into account.

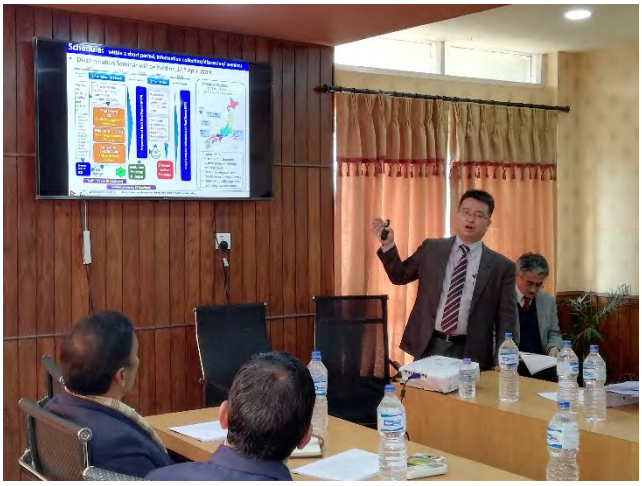
Closing remarks/ expectation from JICA

- Mr. Nishimura, Representative, JICA Nepal Office, stated his appreciation to all stakeholders who gathered the WG for the improvement of future urban transport in Kathmandu Valley. He also emphasized further actions expected to the Nepali Government, which is summarized below;
  - After dissemination seminar in April, JICA expects Nepali Government to prepare official request for any assistances on Technical Assistance and Preparatory Survey (Feasibility Study), and to submit the applications for official requests to the Embassy of Japan through the Ministry of Foreign Affairs in Nepal.
  - This WG should be kept as a valuable platform for further discussion among stakeholders.

The meeting was ended on 16:15.

[END]

Photos of the Meeting



Appendix 2 Invitation Program to Japan

APPENDIX 2 INVITATION PROGRAM TO JAPAN

2.1 Invitation Program Overview

2.1.1 Title

Invitation Program to Japan for Urban Transport Sector Development (Nepal)

2.1.2 Duration

The duration of invitation program was 8 days from February 23, 2019 to March 2, 2019 (including the travel days).

2.1.3 Participants

Seven participants from Democratic Republic of Nepal including seniors officials of the Ministry of Physical Infrastructure and Transport (MOPIT) and Ministry of Finance (MOF). The list of invitees is shown below.

Name	Affiliation	Position
Mr. Gopal Prasad Sigdel	Ministry of Physical Infrastructure and Transport	Joint Secretary
Mr. Rabindra Nath Shrestha	Ministry of Physical Infrastructure and Transport, Department of Roads	Director General
Mr. Keshab Kumar Sharma	Ministry of Physical Infrastructure and Transport, Department of Roads	Deputy Director General
Mr. Harisharan Pudasaini	Ministry of Finance, Budget Division	Joint Secretary
Mr. Hari Prasad Bashyal	Ministry of Physical Infrastructure and Transport	Joint Secretary (Admin.)
Mr. Deepak K C	Ministry of Physical Infrastructure and Transport, Department of Roads	Senior Divisional Engineer
Mr. Prem Parajuli	Ministry of Finance, Financial Management Division	Section Officer

2.1.4 Background of Invitation

This survey aims at exploring potential JICA support scheme for short-term, mid.-term, and long-term projects. Therefore, deepening understanding of Japanese urban transport system and technologies expected to be applied in potential projects is necessary through opportunity to meet and exchange with Japanese companies. In addition, introducing of Japanese advanced maintenance technology of grade-separated roads and urban transport system with focus on public transport is also important.

Considering the above, invitation program was planned and implemented for senior officials from MOPIT and relevant Nepalese government agencies.

2.1.5 Objectives of Invitation

The objectives of invitation program are as follows.

- To deepen the understanding on Urban Transport Policy in Japan for smooth implementation of this project;
- To experience various urban railway systems in Japan and to deepen understanding of the differences of each system;
- To understand the cooperation between public transport policy and urban development, as well as the importance of public transport-integrated urban development through lecture from local governments.
- To understand civil engineering/ construction technology in Japan on road and railway structures (with ideo etc.) and explore their applicability in Nepal;
- To establish an opportunity to exchange with Japanese companies with knowledge and skills related to this project, to build a network with Japanese companies;
- To deepen understanding of Japanese assistance and interest in future.

2.2 Details of the Invitation Program

2.2.1 Schedule

The detailed schedule in the Guidebook of the Invitation Program is described at the back of this appendix.

2.2.2 Activities Report

(1) Courtesy Call to JICA

The official program started the day after the arrival of invitees. The first visit was to JICA Headquarter, where the survey team made a briefing on the schedule and points of attention.

In addition, tablets were lended to each invitee so that they could use for reading the materials, taking pictures, and searching for location during the course of the program.

After the briefing, a courtesy visit to Mr. Harahira, director of JICA South Asia, was conducted (the Study Team did not accompany).

Figure 2.1 Briefing at JICA Headquaters

(2) Courtesy Call to MLIT

The survey team did not accompany.

(3) Study visit at Odakyu Railway Depot

1) Meeting

Before the site visit, officers from Odakyu Electric Railway gave a lecture on different types of service trains, service operation system, maintenance and management, as well as the business model of Odakyu.

Among various topics, responsibility of the Kitami Railway Depot and measures in consideration of the surrounding environment were explained. Securing a depot site is crucial when introducing rail-type public transport in Kathmandu and measures to the surrounding environment will be essential.

The invitee raised questions about the procedure of land acquisition for rail track and the contents of compensation at that time. The answer was that negotiation took place with landowner in the process of obtaining an agreement, yet the land acquisition might be conducted based on the law as a last resort. The land tenure can be under the name of Odakyu Electric Railway or local government depending on the situation of acquisition and ownership.

In addition, question on train braking distance is raised, and in Japan, the braking distance of the train was once defined by the law, and it was answered that it can stop at 200 m or less when applying a sudden brake at the speed of 60 km/h.

Figure 2.2 Lecture on Raiway Business and Operation

2) Study tour at Kitami Railway Depot

After the lecture, the invitees moved to the workshop where maintenance and inspection are undertaken.

Figure 2.3 Workshop Visit

3) Visiting Shinjuku Bus Terminal

Upon returning from Kitami Railway Depot, the Study Team guided the invitees for a visit of Shinjuku Bus Terminal which is an integrated terminal for transfer convenience between railway, bus and taxi. The survey team explained the outline of the facilities and the operateion of the bus terminal.

(4) Lectures at Oriental Consultants Global

On the 2nd day, the invitees attended a lecture at Oriental Consultants Global on construction technology of flyover, underpass, and shield-tunnel for underground railway.

Figure 2.4 Lectures at Oriental Consultants Global

1) Construction Technology of Flyover

Mr. Koichiro Oharu, Deputy Director, Road Engineering Department, Oriental Consultants Global Co., Ltd., gave a lecture on the flyover construction methods for erection of still girder, pier column and foundation with pros and cons of each method.

For steel girder, large block erection method is suitable for busy intersection as it requires only road closure for one night and does not need to secure work space/site around the intersection. For column, the precast pier conlumn is one of the advanced method which can complete within short time and requires narrow working space. For foundation, PC well and rotation steel pile were the methods that reduce the construction space and period.

The invitees were very interested in the applicability of these techniques in Kathmandu. Questions about the block size of the PC well were asked.

2) Construction Technology of Underpass

Mr. John Paul Baracas, Engineer from Ando Hazama Corporation, gave a lecture both on open-cut and non-open-cut methods for underpass construction. The methods that relatively less disturb the traffic are box jacking method and element jacking method which are suitable for working underneath high traffic road section.

Moreover, it was explained that HEP & JES construction method uses pre-stressed concrete steel strands to pull the excavator rather than hydrolyc jacks to advance excavation.

3) Shield Tunnel for Underground Railway

Mr. Yoshihisa Asada, General Manager, Transport Planning & ICT Department, Oriental Consultants Global Co., Ltd., gave a lecture on the shield tunelling under airport runway.

As an example of employment in Japan, the route of Keihin Electric Express Line at Haneda Airport was introduced, and its outline, construction method, and technical difficulties in construction were explained. Since the construction works done while the runway was being operated, the explanation includes careful construction such as drilling management system and the dynamic observation at the time of aircraft approaching.

The introduction of east-west railway line in Kathmandu may require passage under the runway of

Tribhuvan International Airport, which impedes east-west traffic. Therefore, understanding of these cases in Japan are helpful for Nepal.

(5) Site Visit for Flyover and Underpass

On the way to Haneda Airport by bus to travel to Hiroshima, on-site inspections of flyovers and underpasses on Tokyo Route No. 318 Ring 7 (Circle 7) was conducted.

The following are the planned travel routes:

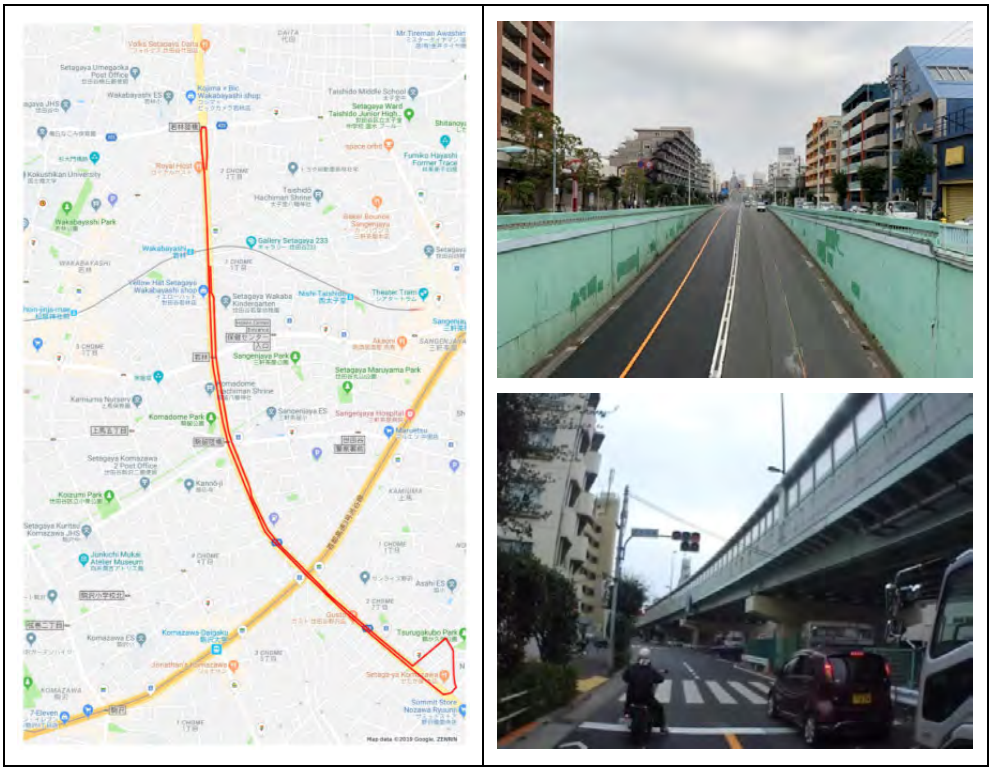


Figure 2.5 Routes for Observing the Underpass and Flyover

(6) Observing Shield Tunnel under Airport Runway at Haneda

The observation of the tunnel under airpor runway was made by riding Keihin Kyuko Railway Line.

(7) Public Transport Ride Experience in Hiroshima

Aiming to get a realistic image of rail-based public transport for Kathmandu, a tour including a public transport ride experience in Hiroshima, whose topography is similar to Kathmandu, was conducted on the 3rd day. Using a smart card (Suica) for riding, smooth ticket gate crossing for any railway operators was an interesting experience. The tour includes the followings:

- Riding AGT (Automated Guided Transit) Astram Line and Kamiyasu Bus Terminal
- Inspection at Yokokawa Station and riding JR line
- Riding Hiroshima Electric Railway line

Figure 2.6 Astram Line and Kamiyasu Bus Terminal

Figure 2.7 JR Kabe Line and Yokokawa Station

Figure 2.8 Hiroshima Electric Railway

(8) Public Transport Policy and Urban Development Integration

On the fourth day, a lecture on public transport policy in Hiroshima City was given by Professor Akimasa Fujiwara, Graduate School of International Cooperation, Hiroshima University. During reconstruction from atomic bombing and motorization, tram system was introduced as symbol of Hiroshima, urban public transport policy for Hiroshima has always been utilized. The lecture also raised about the heavy rain disaster in July 2018. Prof. Fujiwara explained based on his experience how to promote road clearance immediately after being affected by heavy rainfall in a large area. In Japan, where the population shrinking, there is a high level of interest from invited guests from Kathmandu, who also experience many disasters, as to which level will be achieved with the goal of achieving post-disaster

recovery compared to before the disaster.

Figure 2.9 Lecture at Hiroshima University

(9) Kumano Tunnel / Hirose Kumano Tunnel inspection

As a case of mountain tunnel in Japan, we went through "Hiroshima Kumano Road", which is a toll road, and observed Kumano Tunnel and Hirose Kumano Tunnel from inside a bus. The invitees confirmed that shelters in the tunnel and safety equipment such as emergency telephones.

Figure 2.10 Kumano Hirose Tunnel

(10) Shinkanse Riding Experience (Hiroshima - Tokyo)

After the tour of Hiroshima, the invitees took a Shinkansen ride to Tokyo Station. The Sanyo Shinkansen operates at a speed of 300 km/h.

Figure 2.11 Riding Shinkansen

(11) Seminar on Nepal Transport Sector

In the afternoon of the fifth day, Seminat on Nepal Transport Sector was held at JICA Global Plaza (Ichigaya), and the exchange between Japanese companies and invitees took place. There were 28 participants from Japanese companies. Mr. Keshab Kumar Sharma, Deputy Director General of DOR, made a presentation at the end of the session.


Figure 2.12 Seminar on Nepal Transport Sector

2.2.3 Schedule of Invitation Program

The detailed schedule of the invitation program is shown below.

Table 2.1 Schedule of Invitation Program

Date	Time	Contents	Location	Accommodation
23 Feb Sat	13:55 ~ 18:30	TG320 Dep. Kathmandu ~ Arr. Bangkok	-	On board
	22:30 ~	TG640 Dep. Bangkok		
24 Feb Sun	~ 6:20	Arr. Narita intl. airport	-	Tokyo
25 Feb Mon	9:30 ~ 11:50	***Courtesy call:*** MLIT and JICA H.Q. Briefing of the schedule	MLIT JICA H.Q.	Tokyo
	12:00 ~ 13:00	Lunch (by JICA H.Q.)		
	14:00 ~ 17:00	***Site visit***: Urban public transport facilities (Railway depot (Odakyu KITAMI railway depot), Multi-modal transport hub at Shinjuku etc.)	Tokyo	
	18:00 ~	Dinner (by JICA Study Team)		
26 Feb Tue	9:00 ~ 10:00	***Lecture:*** Construction technologies for flyover/underpass	OCG	Hiroshima
	10:00 ~ 11:00	***Lecture:*** Shield tunneling method under airport runway		
	12:30 ~ 13:00	***Site visit:*** ・ Flyover/underpass along Circular Road 7 ・ Railway under airport runway at Haneda airport On the way to Haneda airport	Haneda Airport	
	14:50 ~ 18:30	***Travel:*** Dep. Haneda Airport (14:50) ~ Arr. Hiroshima Airport (16:20) [Flight: ANA 681] Airport to Hotel by Bus		

Date	Time	Contents	Location	Accommodation
27 Feb Wed	8:30 ~ 11:00	***Site visit***: Public transport system in Hiroshima to Miyajima ・Astram line (AGT): under- ground and elevated section ・Railway station with bus terminal at Kamiyasu St. ・Inter-city railway ・Station plaza/area dev. Yokokawa St.) ・Ferry to Miyajima	Hiroshima	Hiroshima
	11:00 ~ 13:00	***Site visit:*** Miyajima/ Itsukushima Shrine [World Heritage]		
	13:00 ~ 14:00	Lunch		
	14:00 ~ 15:00	***Travel:*** ・Hiroshima electric railway (tram/street car)		
	15:00 ~	***Site visit***: Hiroshima Peace Memorial Park		
28 Feb Thu	7:00 ~ 8:30	***Travel:*** Hiroshima St. to Hiroshima Univ. by Sinkansen (High speed rail) and bus	Hiroshima	Tokyo
	8:30 ~ 10:00	***Lecture:*** Urban transport policy and urban development in Hiroshima city (Prof. Fujiwara, Hiroshima University)	Hiroshima University	
	10:00 ~ 13:00	***Site visit***: Tunnel (Kumano tunnel and Kumano Hirose tunnel)	Hiroshima	
	13:53 ~ 17:53	***Travel:*** by Shinkansen (High speed rail) Hiroshima Station (13:53) ~ Tokyo Station (17:53) [Nozomi No.132]	-	
1 Mar Fri	am ~ 12:00	Free time	JICA Ichigaya	On board
	12:00 ~ 13:00	Lunch (by JICA H.Q.)		
	15:00 ~ 17:00	Networking program with Japanese companies		
2 Mar Sat	0:30 ~ 05:25	TG661 Dep. Haneda intl. airport ~ Arr. Bangkok	-	-
	10:30 ~ 12:45	TG319 Dep. Bangkok ~ Arr. Kathumandu		

Appendix 3 Dissemination Seminar

APPENDIX 3 DISSEMINATION SEMINAR

The agenda, the minutes and photos of Dissemination Seminar are described from the following page.

MOPIT
Ministry of Physical Infrastructure and Transport
KVDA
Kathmandu Valley Development Authority

JICA ORIENTAL CONSULTANTS GLOBAL
PADECO

Dissemination Seminar
of
JICA Data Collection Survey on Urban Transport in Kathmandu Valley

AGENDA

VENUE: **Main Hall and Exhibition Room, Hotel Shanker, Lazimpat**

DATE: **12th April 2019 (Friday)**

Time	#	Description
8:30-9:00		Registration
9:00-9:10	1	Opening remarks Opening Speech: *Er. Gopal Prasad Sigdel, Joint Secretary, MOPIT* Guest Speech: *Mr. Madhu Sudan Adhikari, Secretary, MOPIT*
9:10-9:20	2	JICA's Assistance to transport sector in Nepal *Mr. Naoki NISHIMURA, JICA Nepal Office*
9:20-9:30	3	Introduction of participants *Governmental officers, Private companies, Academic field, Development partners, Japanese companies*
9:30-9:50	4	Outline of JICA survey (General Findings) - Explanation from study team: *Mr. Yoshihisa ASADA, Team Leader, JICA Study Team (JST)* - Q&A
9:50-10:00	5	Tea/coffee break
10:00-10:40	6	Mid-term solution: Road improvement project (Proposal) - Explanation from study team (Flyover/underpass, Manohara Corridor): *Mr. Koichiro OHARU, JST* - Findings of invitation program for latest technologies and Japanese engineering solutions: *Mr. Keshab Kumar Sharma, Director General, MOPIT-DOR (Dept. of Road)* - Q&A
10:40-11:20	7	Short-term solution: Traffic management project (Proposal) - Explanation from study team: *Mr. Yoshiya NAKAGAWA, Deputy Team Leader, JST* - Pilot improvement of motor-cycle box and arrangement of bus-bays: *Mr. Deep Barhi, SDE, MOPIT-DOR & Ms. Bandana Acharya, Engineer, DOR-RSTU (Road Safety & Traffic Unit)* - Challenges by private companies for urban transport services: *Mr. Ram Rimal, Director, RamLaxman Pvt.* - Q&A
11:20-12:00	8	Long-term solution: Urban railway system development (Proposal) - Explanation from study team: *Mr. ASADA, Team Leader, & Mr. Hiroyuki AIZAWA, JST* - Findings of invitation program of urban railway system in Tokyo and Hiroshima: *Mr. Deepak K C, SDE, MOPIT-DOR* - Current development plan in Eastern area: *Mr. Bhagawat B. Khokhali, Urban Planner, KVDA* - Q&A
12:00-12:10	9	Closing remarks JICA Nepal Office: Guest Speech: *Mr. Madhu Sudan Adhikari, Secretary, MOPIT*
12:10 -	10	Networking Lunch, Japanese companies presentation
- 15:00	11	Exhibition at sub-room (15:00: Room closed)

MC: Ms. Brinda Singh, PR Officer, JICA Nepal Office,
Facilitator for session # 6, 7 and 8: Dr. Madhu Sudan Acharya

Minutes

of

Dissemination Seminar

for

Data Collection Survey

on

Urban Transport in Kathmandu Valley

Kathmandu, April 17th 2019

Er. Gopal Prasad Sigdel
Joint Secretary
Ministry of Physical Infrastructure
and Transport

Mr. Yoshihisa ASADA
Team Leader
JICA Study Team

The Dissemination Seminar (hereinafter referred to as "the Seminar") for "Data Collection Survey on Urban Transport in Kathmandu Valley" (hereinafter referred to as "the Survey") was held on April 12th 2019 under the coordination among Ministry of Physical Infrastructure and Transport (hereinafter referred to as "MOPIT") and JICA based on the Concept Note of which reference number is JST-UTK-20190327-001. The Seminar was chaired by Er. Gopal Prasad Sigdel, Joint Secretary of MOPIT. List of attendees is attached as Annex 1. The agenda for the Seminar is attached as Annex 2.

In the welcome speech session, the Chairperson made a welcome speech and the Secretary of MOPIT provided the Guest Speech for opening remarks.

Following the above opening remarks, Representative of JICA Nepal Office, Mr. Nishimura, presented the JICA's assistance to transport sector in Nepal as follows;

- Explanation of various types of Japanese official development assistance (Technical cooperation, Grant aid and ODA Loan)
- Experiences on Japanese grant assistance in transport sector in Nepal
- Introduction of Japanese ODA loan project and its advantage (interest rate: 0.01%, repayment period: 40 years and grace period: 10 years)
- Introduction of recommendations of the Urban Transport Master Plan in 2017 done by JICA

In his summary, he stated as follows;

- In the past, Japan supported the transport sector development mainly by Grant Aid. Hence, the scale of the project was limited. For achieving the Nepali government's target to become the middle income country by 2022, much more investment is necessary. ODA Loan will be more and more important modality to support large scale infrastructure development.
- JICA's focuses in the transport sector are (a) Urban Transport in Kathmandu Valley and (b) Inter-city road that connects between Kathmandu Valley and other urban areas or border. In this Data Collection Survey, basing on the recommendations in the Master Plan, Short-term, Middle-term and Long-term measures to tackle the urban transport related issues will be discussed.

Then, Master of Ceremony, Ms. Brinda Singh, PR officer, JICA Nepal Office, facilitated the introduction of participants from a) government officers, b) academics, c) private companies and institutions, d) Embassy of Japan, JICA and development partners and e) Japanese private companies. She also introduced the company names for only exhibition of their technologies.

After the introduction of participants, Team Leader of the Survey, Mr. Asada, explained the outline of JICA Survey which includes objectives and general findings of the Survey. After his presentation, the following comments and suggestions are raised from the participants:

- ADB stated that it would be important to coordinate among government agencies/institutions for implementation of plans for urban transport field (especially mass-transit) after prioritized even several different plans are existed.
- Tootle CEO shows doubt on road development trend because it may cause more vehicles, therefore, this trends (development of roads) are not suitable for the current trends as mobility improvement, such as ride-sharing.
  - Mr. Asada replied that road network/infrastructure provision is still quite important even new Mobility service industries are started.

After the above session, it had small break of coffee/tea at the Exhibition room, which Japanese companies display their technologies. Some individual inquiries were happened among seminar participants and exhibitors.

The following session is named as "Mid-term solution: Road improvement project". At first, Mr. Oharu, member of the Study team, made the presentation of the study team's proposal (Koteshowor-Tinkune intersection improvement). Then, MOPIT-DOR, Director General, who is the member of the Invitation Program in Japan, made his presentation for the findings of Japanese technologies for flyover/underpass as well as the short video of driving on flyover/underpass along the circular road No.7 in Tokyo. After the presentation, the following comments and suggestions are raised from the participants:

- JICA Nepal office, Mr. Nishimura, noted that Koteshowor intersection would still be congested even though a mass-transit is introduced in 2030.
- RamLaxman Pvt. asked the applicability/effectivities of traffic congestion information in Nepal, which has been utilized in Japan.
- JICA study member, Mr. Miyazaki, requested to all of participants to provide their view on evaluation criteria for improvement alternative for Koteshwor-Tinkune intersections such as flyover vs. underpass, especially weight of each evaluation item.

The following session is named as "Short-term solution: Public Transport & Traffic management project". Three (3) presentations were made, such as a) Study team's proposal presented by Mr. Nakagawa, Deputy Team Leader of the Study team, b) Pilot improvement of motor-cycle box and arrangement of bus-bay presented by Mr. Deep Barhi, SDE, MOPIT-DOR, and c) Challenges by private companies for urban transport services presented by Mr. Ram, Director, RamLaxman Pvt. After the presentation, the following comments and suggestions are raised from the participants:

- Shajha Yatayat, Bus operator, inquired whether the proposed lane width could manage the motorcyclist to pass through between stopped cars to reach the motorcycle-box.
  - Mr. Mull answered that this proposals, e.g. motorcycle-box, is as the Pilot Project, based on the successful other countries' experiences, so that proposed lane width might have enough space for motorcyclists. Since these ideas are a trial-basis, we would like to see the effectiveness of these concepts as well as to see the behavior changes of drivers and motorcyclists. Note that we, together with site-confirmation with traffic police, will put on the rubber cones as center-line divider to avoid any driving out of the lane.
- Shajha Yatayat also expressed his concerns about traffic safety, especially for pedestrian to cross the roads at intersection with safe. He asked whether any improvements are planned at New Baneshwor intersection.
  - Mr. Mull replied that the new pedestrian bridges will be installed near the New Baneshwor intersection.

The final session is named "Long-term solution: Urban Railway System Development", which consists of three (3) presentations, such as a) Study team's proposal, presented by Mr. Asada and Mr. Aizawa, b) Findings of invitation program of urban railway system in Tokyo and Hiroshima, presented by Mr. Deepak, SED, MOPIT-DOR and c) Current development plan in Eastern area of Kathmandu Valley, presented by Mr. Khokhali, Urban planner, KVDA. At his presentation of b) Findings of invitation program of urban railways system, he showed the i) experiences on various types of urban railway system, ii) features of Hiroshima, where is similar size/geography (residential area on hilly land) with public transport system plan and development in Hiroshima as a good

example for Kathmandu, iii) lessons learnt: Integration with urban railway system, Feeder Bus Terminal linked to Station, Station square/plaza connecting various modes of transport, and iv) other important points to be applied to Kathmandu: Depot (its scale/size, required functions, potential to serve a park), Railway tunnel under airport runway (during operation) and Convenient payment system such as IC card.

After the presentation, the following comments and suggestions are raised from the participants:

- MOPIT-DORW stated his concern about the difficulties of land acquisition for Northern route, especially in urban area, and expressed his preferences of the route on the Araniko Highway.
  - ➢ Mr. Asada replied, that is why we proposed the Northern route because it can be integrated with the new city development by KVDA. Also, maximum usage of lands along the rivers and usage of brick factory for depot in future are possible if well coordination with KVDA at this initial stage.
- Some Audience (floor participant) asked whether KVDA has the mid.-term development plan for land use, and how to coordinate with various studies for mass-transit plans among different governmental agencies and municipalities.

After the above three (3) sessions, the Terrain model, which was developed for future studies on Koteshwor-Tinkune intersection, was handed over by Ms. Asakura, Chief Representative, JICA Nepal Office to MOPIT.

For the Closing Remark session, the Closing Speech was delivered by Ms. Asakura, Chief Representative, JICA Nepal Office. And, the guest speech for closing remarks was made by Dr. Bhai Kaji Tiwari, Development Commissioner, KVDA.

MC announced that all of the program in main hall is finished with the kind attentions and involvements, and invited all the participants to the networking lunch including the presentation from Japanese companies' technologies. In addition, she announced that the exhibition from Japanese companies will be continued until 15:00 at the Exhibition room.

[END]

Dissemination Seminar

12th April, 2019, Hotel Shanker, Lazimpat, Kathmandu, Nepal

<table>
<tr><td> 
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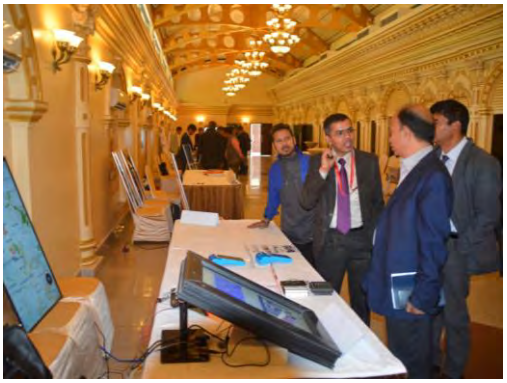
<tr><td>Entrance</td><td>Reception</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Seminar Venue</td><td>MC
Ms. Brinda Singh, PR Officer, JICA Nepal Office</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Opening Remarks/ Opening Speech
Er. Gopal Prasad Sigdel, Joint Secretary, MOPIT</td><td>Opening Remarks/ Guest Speech
Mr. Madhu Sudan Adhikari, Secretary, MOPIT</td></tr>
</table>

	
JICA's Assistance to Transport Sector in Nepal Mr. Naoki NISHIMURA, JICA Nepal Office	Outline of JICA survey Mr. Yoshihisa ASADA, Team Leader, JICA Study Team
	
Seminar Scene (1)	Seminar Scene (2)
	
Seminar Scene (3)	Seminar Scene (4)
	
Tea break	Presentation of Mid-term solution (1) Mr. Koichiro OHARU, JICA Study Team

	
Presentation of Mid-term solution (2) Mr. Keshab Kumar Sharma, Director General, MOPIT-DOR (Dept. of Road)	Facilitator for Mid-term, Short-term and Long-term presentations Dr. Madhu Sudan Acharya
	
Q&A of Mid-term solution (from participants)	Q&A of Mid-term solution (answered by JICA Study Team)
	
Presentation of Short-term solution (1) Mr. Yoshiya NAKAGAWA, Deputy Team Leader, JICA Study Team	Presentation of Short-term solution (2) Mr. Deep Barhi, SDE, MOPIT-DOR

	
Presentation of Short-term solution (3) Mr. Ram Rimal, Director, RamLaxman Pvt.	Q&A of Short-term solution (from participants)
	
Q&A of Short-term solution (answered by MOPIT/ JICA Study Team)	Presentation of Long-term solution (1) Mr. Hiroyuki AIZAWA, JICA Study Team
	
Presentation of Long-term solution (2) Mr. Deepak K C, SDE, MOPIT-DOR	Presentation of Long-term solution (3) Mr. Bhagawat B. Khokhali, Urban Planner, KVDA
	
Handover of Terrain Model to MOPIT from JICA (Koteshwor-Tinkune Section)	Closing Remarks/ Closing Speech Ms. Yumiko ASAKUMA, Chief Representative, JICA Nepal Office

	
Closing Remarks/ Guest Speech Dr. Bhai Kaji Tiwari, Development Commissioner, KVDA	Company exhibitions (1)
	
Company exhibitions (2)	Japanese company presentation

Appendix 4 Traffic Volume Survey

APPENDIX 4 TRAFFIC VOLUME SURVEY

4.1 Technical Specification

The technical specification of the traffic volume survey is described from the following page.

TERMS OF REFERENCE

Traffic Volume Surveys
for
Data Collection Survey on Urban Transport Sector in the Kathmandu Valley
in
the Federal Democratic Republic of Nepal

1. Background and Objective

The Government of Nepal and Japan International Cooperation Agency (JICA) agreed to implement the "Data Collection Survey on Urban Transport Sector in the Kathmandu Valley" with funding from JICA. Oriental Consultants Global and PADECO (hereinafter referred to as "JICA Project Team") were appointed to undertake this project in conjunction with the Government of Nepal.

The project aims to collect basic information on urban transport sector in the Kathmandu Valley. A core part of this project is to identify programmes for improving road traffic (e.g., road expansion, intersection improvements) to realise the harmonious development of urban transport. In this regard, the Traffic Volume Survey will be conducted at key intersections across the valley to measure traffic patterns and volumes, which are necessary to consider an appropriate approach for prioritizing intersection improvements.

2. Outline of the Survey

The Traffic Volume Survey (TVS) consists of traffic volume counting (directional) at intersections and roundabouts in the Kathmandu Valley.

The TVS will be implemented by the local consultant. The required qualifications of applicant firms are specified as below:

- Experience in leading medium-scale surveys.
- Capabilities in using Excel and to output the expected deliverables, including appropriate data checks.
- Have core staffs (either in-house or by recruitment) who are qualified as managers and key operators in the Project Office for the survey implementation, such as Chief Supervisor and Chief Data Processing. The core staffs are expected to read, speak and write in English. They should have experience in communicating with public agencies (e.g., Police).

General schedule

The contract for the TVS shall be awarded by **Monday 21 January 2019**. The Contractor shall report their deliverables based on the schedule of TVS shown in table 1. The contractor must obtain the approval from the JICA Project Team before proceeding with TVS. Survey implementation and data formulation have to be completed by **Friday 15 February 2019**.

Reporting requirement

The Contractor shall report the progress to the JICA Project Team based on the following schedule:

- On conducting the surveyors' training
- At the start and end of the pilot survey
- During the implementation of the survey
- During the input of the coded data in the computer

The final outputs including the Final Survey Report shall be submitted to the JICA Project Team within two (2) weeks of completion of the TVS. See Section 6 Deliverables for further details.

Table 1: Schedule of TVS

		2019 Jan				2019 Feb			
	Week	1	2	3	4	1	2	3	4
JICA Project Team									
Bidding and Contract Procedure									
Preparation of Survey Forms									
Inception Meetings									
Training of Supervisors									
Implementation Monitoring									
Data Error Check									
Contractor									
Establishment of Project Office for Survey Implementation									
Recruitment of Surveyors and surveyors' Training									
Pilot survey									
Printing of Various Documents for TVS									
Implementation of TVS									
Inspection and Editing									
Data Input and Data Check/Correction									
Final Reporting									

3. Scope of Work

3.1. Location

The figure 1 shows the locations of the TVS.

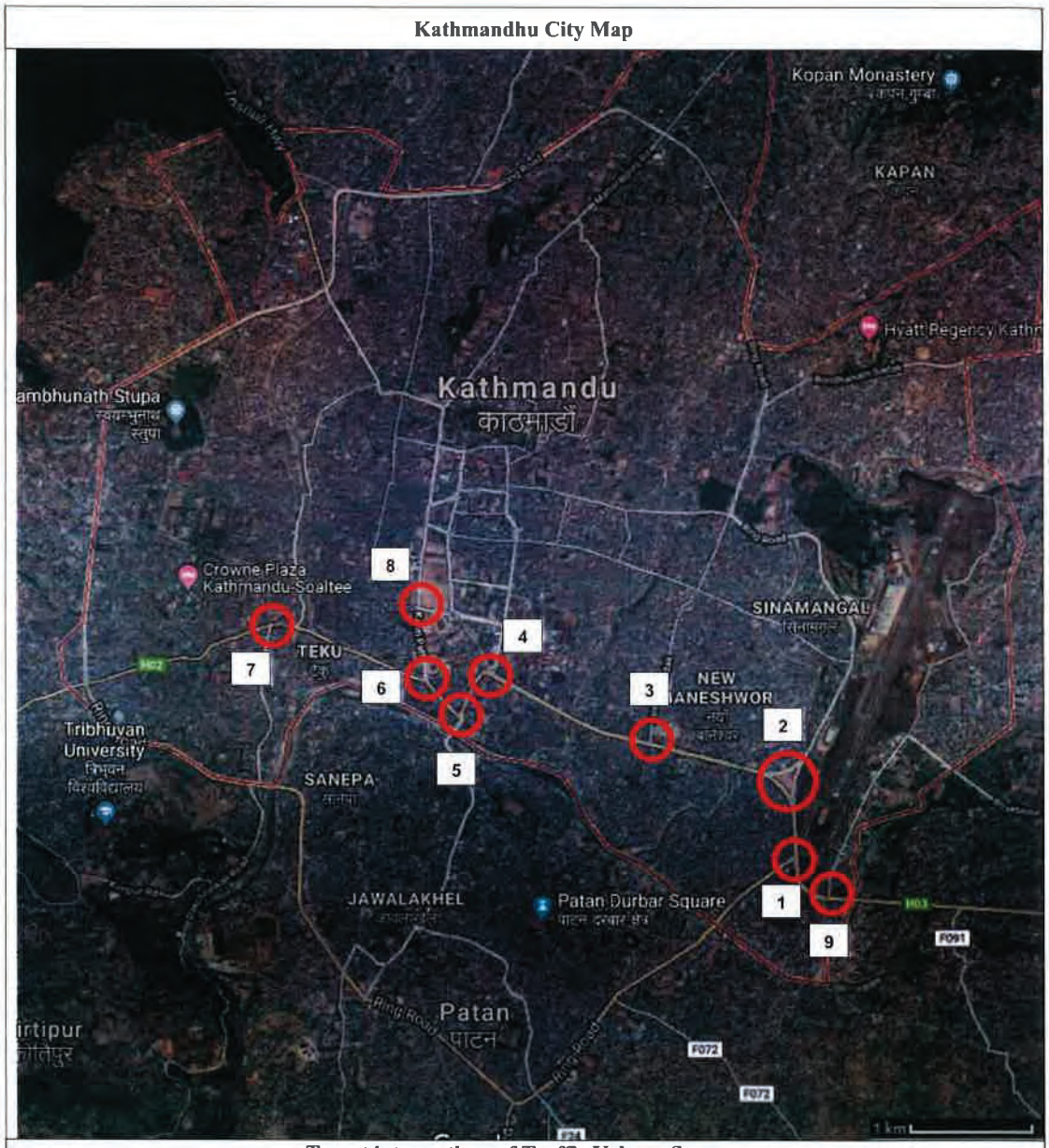


Figure 1: Location of TVS

The survey locations and numbers of intersection legs are provisional, and the bidders are required that the financial proposals should be estimated as per the above locations and number of intersection legs. Quotation shall be made based on the above condition (the JICA Project Team and a Contractor shall agree and finalize the contract price in this condition). However, the JICA Project Team can amend the survey location(s) and number of intersection leg(s) before finalizing the Inception Report. The contract price and survey specification may be adjusted based on mutual understanding of the JICA Project Team and the Contractor.

3.2. Survey Schedule

The TVS shall be conducted on a weekday (either Monday, Tuesday or Wednesday) in a single week, excluding public and school holidays. To complete the TVS of 9 locations within a limited timeframe, three surveys will be conducted in a single day at three locations (1-day survey at each location). The Contractor shall specify holiday(s) that may affect the implementation of TVS in the proposal. The Contractor can propose the schedule of TVS surveys in their Response to the TOR (see the proposed schedule in attachment 1). In the event of unusual traffic conditions on a selected survey day (e.g., major accident, or closure of major roads for whatever reason), surveys may need to be rescheduled. In this case, the Contractor must inform the JICA Project Team with a revised timetable.

3.3. Survey Duration

For each location of the TVS, the surveys shall be conducted for 15 hours continuously (from 6 am to 21 pm on the same day). The peak hour shall be set as the working time of public-sector officers: 8-10 am and 16-18 pm. The Contractor may propose a different time period if their working hours differ (due to winter season). The TVS result shall be summarized in every 15 minutes.

3.4. Vehicle classifications

For vehicle counting purpose, the following classification of vehicle types should be utilised for implementation of the TVS.

Table 2: Vehicle Type Classifications

Code	Description
1	Motorcycle
2	Tempo
3	Car (Passenger car)
4	Taxi
5	Light & Medium Truck (up to 3 axles)
6	Heavy Goods Vehicle (including Trailer, 4+ axles)
7	Micro BUS
8	Mini BUS
9	Large size BUS

3.5. Methodology of Traffic Volume Survey

- It is recommended that the surveyors have mechanical, hand-held, push-button, counting devices (such as clickers) for tabulating vehicles. The surveyors should also prepare equipment for video monitoring.
- Team members must be placed on the roadside to secure an unobstructed view of vehicles passing.
- For each survey period, the surveyors should conduct the survey continuously to gain a 100% sample of vehicles.
- Both directions (e.g., north-south and south-north, east-west and west-east) shall be counted and recorded separately, with a breakdown of vehicle type.
- The number of all moving vehicles will be counted continuously and recorded on a survey sheet every 15 minutes (this will be done using recorded videos).

3.6. Arrangement with Relevant Police Authorities

Cooperation and coordination with relevant police authorities are required for implementation of the TVS. The JICA Project team will arrange a formal letter to be sent to the local government unit (i.e., Kathmandu City, Lalitpur City) and Traffic Police (i.e., Metropolitan Traffic Police Division). The proceeding arrangements and communication with the relevant authorities shall be undertaken by the Contractor.

4. Traffic Volume Survey at Intersections

The TVS shall be conducted at 9 intersections from 06:00 – 21:00. The objective of the TVS is to obtain directional traffic volume of all moving vehicles at the selected intersections and roundabouts. The components of the TVS are described as below:

<u>Video monitoring</u>

- Video monitoring shall be used to record directional traffic volumes of vehicles and pedestrians for the entire period of the TVS (15 hours). Surveyors will count all vehicles by type and pedestrians based on recorded videos. For pedestrians, manual counting may be required to ensure data quality.
- Videos will also be used to identify the surrounding environment of the intersections and roundabouts, such as turning lanes, vehicle positions.
- Setting of video monitoring such as locations and angle of monitoring shall be discussed with the JICA Project Team.
- The Contractor may propose an efficient method of digital monitoring using advanced technology (such as drones from an aerial viewpoint).

<u>Items to be Collected by Manual counting</u>

- In case of manual pedestrian counting, directional traffic volume of pedestrians by effective green time shall be counted continuously and recorded on a survey sheet every 15 minutes.
- Setting of signal phase shall be identified and recorded. If there is no signal or traffic is controlled by police, this should be discussed with the JICA Project Team.

- Congestion length at intersection shall be recorded to understand actual traffic capacity and spillovers. Details shall be discussed with the JICA Project Team.

The Contractor shall submit the data coded into spreadsheet format, as well as raw survey data. In order to minimise errors on data entry, double entry of data should be practiced.

5. Other Requirements

5.1. Organization Structure for Survey Implementation

The Contractor shall formulate the team of surveyors to implement the TVS in the Valley as soon as receiving the contract award. An example of the organization chart is shown below.

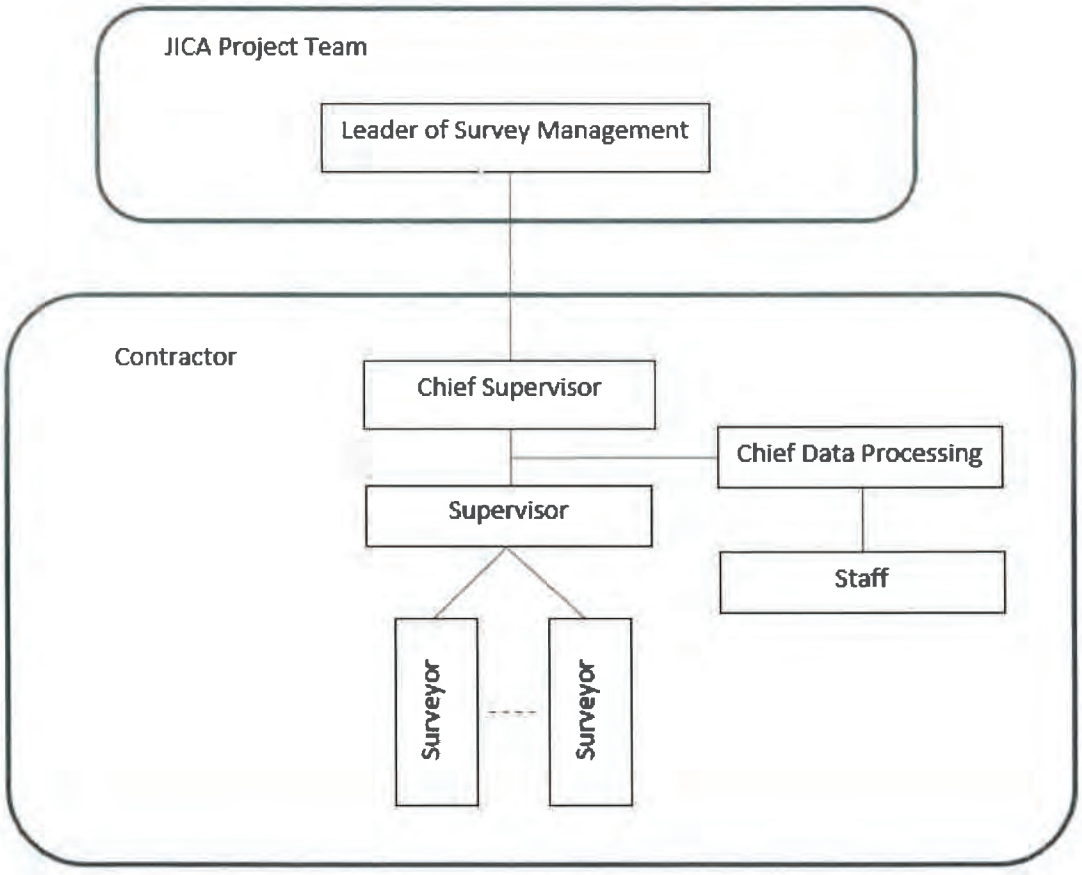


Figure 2: Office Organization (Example)

5.2. Recruitment of Surveyors and Surveyors' Training

The Contractor shall recruit sufficient numbers of surveyors right after signing the contract with the JICA Project Team and select capable surveyors to implement the TVS. The Contractor shall select surveyors based on the following requirement:

- To have graduated from secondary school

There are some conditions regarding training of surveyors.

- Training of supervisors shall be performed by the Contractor.
- Training of surveyors shall be conducted by supervisors who will be trained through the pilot survey. The JICA Project Team expert can support such training.

5.3. Preparation of Various Documents for TVS

After the suitability of the survey form has been be confirmed by means of the Pilot Survey, the Contractor shall prepare print outs of the various documents to be used for TVS.

5.4. Data Input and System Error Check

a. Data Input

The data of valid survey forms shall be input in the format advised by the JICA Project Team. Double data entry shall be used to minimize error.

b. System Error Check

The system check is the final check work by the computer and the revision work of the input data shall be repeated until the errors are resolved. The kinds of checks to be conducted as shown in the following table. If data contain an error, the Contractor will be responsible for correction.

Table 3: Type of Check

Type of Check	Contents of Check	Remarks
Numerical Check	Check whether data numerical or not	Check of single item
Range Check	Check whether within the prescribed range or not	
Over-lap Check	Check whether the figure is over-lapped or not	Check among the Items
Logical Check	Logical Check among the items	

5.5. Making original files

After completing the system check of input data, those data shall be deemed the original data. The original data format is the same as the input data.

6. Deliverables

The Contractor shall submit the deliverables listed below by the agreed deadline. For deliverable 4, the number of vehicles counted coupled with their directional movements at each intersection should be summarized in a diagram as shown in figure 3.

Table 4: List of Deliverables

No.	Deliverables	Specification	Deadline
1	Inception Report	- Report shall include methodology, survey schedule, management structure, and other technical and administrative plans.	24 January 2019 (3 days after signing the contract)
2	Survey result data after correction of errors	- Files shall be submitted in MS Excel format. - JICA Project Team provides the data input sheet and required format.	7 February 2019
3	Set of original survey forms	- All filled forms shall be submitted.	7 February 2019
4	Diagram of traffic volume surveys	- The number of vehicles counted and their directional movements should be summarized as shown in figure 3.	7 February 2019
5	Final Survey Report	The report shall include the following information: - Printed survey results (No.2) - Diagram of traffic volume surveys (No. 4) - Compliance explanation to requirements of the TOR; - Photos of surveys, showing actual activities of TVS with proper explanations - Location map of the surveys; and - Administrative report such as schedule, implementation structure and list of surveyors. - one (1) hard copy and one (1) soft copy (e.g., CDR, USB memory stick)	15 February 2019 (1 week after submission of deliverables 2, 3 and 4)

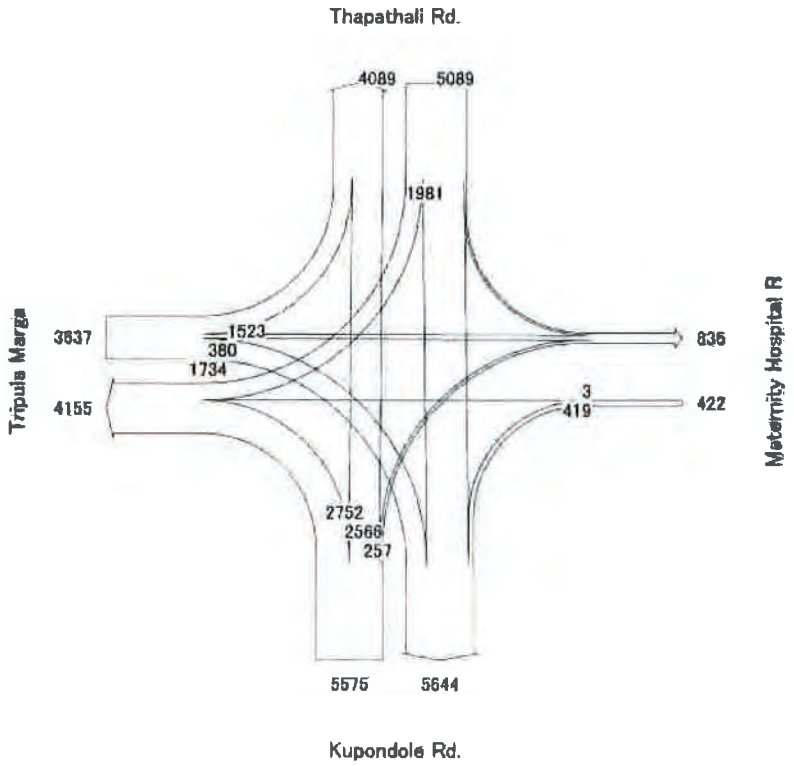


Figure 3: Diagram of Traffic Volume Counts with Directional Movements

7. Payment Schedule

- Advance payment is acceptable up to 40% of the total amount of contract price.
- The remaining payment, or 60% of the total contract amount, shall be paid on submission and satisfactory completion of Deliverable 5, the Final Survey Report.

Attachment 1: Proposed TVS Schedule

Date	Day	Item	Note
08-1	T	Bidding announcement	4-Jan: Pre-announcement
09-1	W		
10-1	H		
11-1	F		
12-1	S		
13-1	S		
14-1	M		
15-1	T		Holiday, arrive in Kathmandu
16-1	W	Close Bidding: Submit to JICA Nepal office	
17-1	H		
18-1	F	Bidding selection complete, award, contract	
19-1	S		
20-1	S	Inception meeting	
21-1	M	Contractor survey preparation, training	
22-1	T	Contractor survey preparation, training	
23-1	W	Pilot survey	
24-1	H	Pilot survey evaluation, follow up	
25-1	F		
26-1	S		
27-1	S	TVS implementation meeting	
28-1	M	Survey 1, inspection & editing	
29-1	T	Survey 2, inspection & editing	
30-1	W		Holiday
31-1	H	Survey 3, inspection & editing	
01-2	F		
02-2	S		
03-2	S	Data input & Data check/correction	
04-2	M	Data input & Data check/correction	
05-2	T		Holiday
06-2	W	additional day for follow up	
07-2	H	Submit survey result data & original survey forms	
08-2	F		
09-2	S		
10-2	S		
11-2	M		
12-2	T		
13-2	W		
14-2	H	Final Survey Report	

4.2 Traffic Volume Survey Overview and Result

4.2.1 Outline

The objective of the Traffic Volume Survey is to obtain directional traffic volume of all moving vehicles as well as pedestrians crossing at 9 intersections, including roundabouts, in the Kathmandu Valley.

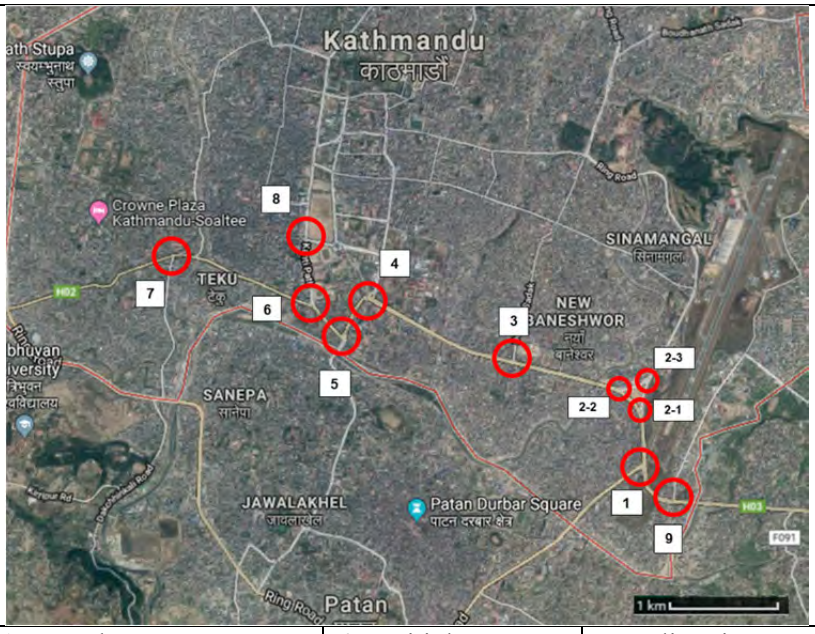
4.2.2 Scope

- The Survey was conducted at 9 intersections in the valley as shown in the map below.
- Traffic volume counting was conducted in each direction of traffic flows for 15 consecutive hours from 06:00 to 21:00 on a weekday (Monday through Wednesday excluding weekends and public holidays).
- To ensure data quality and accuracy, video monitoring was used to record directional traffic volumes of vehicles and pedestrians for the entire period. Surveyors counted all vehicles separately and recorded at every 15-minute interval.
- Manual counting was used to record the setting of signal phase by effective green time and congestion length.

4.2.3 Vehicular classification

1) Motorcycle
2) Tempo
3) Car
4) Taxi
5) Light Truck
6) Heavy Truck
7) Micro Bus
8) Mini Bus
9) Large Bus

4.2.4 Intersections



1. Koteshwor	4. Maitighar	7. Kalimati
2. Tinkune (2-1, 2-2, 2-3)	5. Thapathali	8. Shahid Gate
3. New Baneshwor	6. Tripureshwor	9. Jadhibuti

Figure 4.1 Location of Intersections

4.2.5 Survey Results

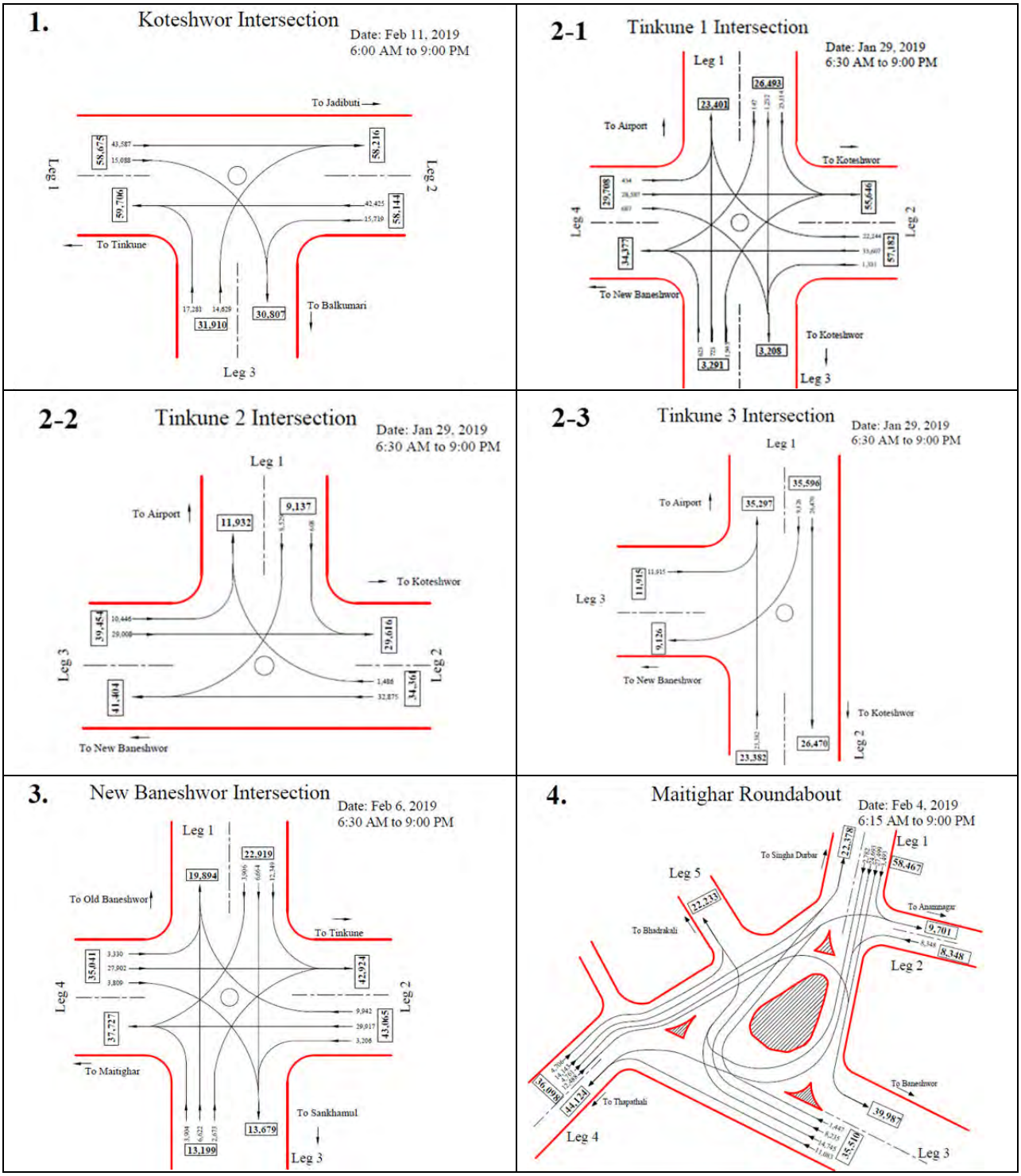
A summary of survey results conducted at 9 intersections is shown as below. Figure 4.2 illustrates the diagram of directional traffic flows and total volumes of all moving vehicles at the intersection. Vehicle Count Share in Figure 4.3 shows the total share of vehicles classified by 9 different types. Hourly Traffic Volume counted as PCU unit is shown in Figure 4.4.

For the purpose of data analysis, traffic volume recorded over a 15-hour period was converted into 24-hour traffic volumes in PCU by adding a 10% of observed traffic. Table 4.1 shows a summary of 24-hour traffic volumes.

The salient points of the survey results are summarized as below:

- For inbound traffic, Shahid Gate (leg 2) records the highest daily traffic volume reaching 89,126 in PCU unit. Koteshwor (leg 1) comes second totaling 64,543 PCU per day, followed by Maitighar (leg 1) with 64,413.
- For outbound traffic, the result shows the clear similarities. The highest daily traffic volume is 81,862 generated at Shahid Gate (leg 1), followed by Koteshwor (leg 1) totaling 65,677.
- Maitighar Intersection has 5 legs with the complex geometric design (Leg 5 is one-way). The highest traffic volume is observed on Leg 1, the North-bound route to Singha Durbar.
- Shahid Gate Intersection is an at-grade intersection with two elevated pedestrian bridges. The East-bound route is one-way only for inflow traffic.
- Motorcycle accounts almost 70% of the total vehicle share at all intersections, followed by car about 15%. Together these two private transports constitute over 85% of the total share of vehicles.
- The results of hourly fluctuation of traffic volume show the trend of rush-hour traffic. Traffic flows during the morning peak hour originate from the East sections and terminate in the city center (or towards the West). The evening peak hour traffic volumes reveal the reverse flows moving from the center (or the West) to the East.

(1) Diagram


1.
Koteshwor Intersection
Date: Feb 11, 2019
6:00 AM to 9:00 PM
To Jadibuti
To Tinkune
To Balkumari
Leg 1
Leg 2
Leg 3
2-1
Tinkune 1 Intersection
Date: Jan 29, 2019
6:30 AM to 9:00 PM
Leg 1
To Airport
To Koteshwor
To New Baneshwor
Leg 4
Leg 2
Leg 3
2-2
Tinkune 2 Intersection
Date: Jan 29, 2019
6:30 AM to 9:00 PM
Leg 1
To Airport
To Koteshwor
To New Baneshwor
Leg 3
Leg 2
2-3
Tinkune 3 Intersection
Date: Jan 29, 2019
6:30 AM to 9:00 PM
Leg 1
To Airport
To New Baneshwor
To Koteshwor
Leg 3
Leg 2
3.
New Baneshwor Intersection
Date: Feb 6, 2019
6:30 AM to 9:00 PM
Leg 1
To Old Baneshwor
To Tinkune
To Maitighar
To Sankhamul
Leg 4
Leg 2
Leg 3
4.
Maitighar Roundabout
Date: Feb 4, 2019
6:15 AM to 9:00 PM
Leg 1
To Singha Durbar
Leg 5
To Bhadrakali
To Anamnagar
Leg 2
To Thapathali
To Baneshwor
Leg 4
Leg 3

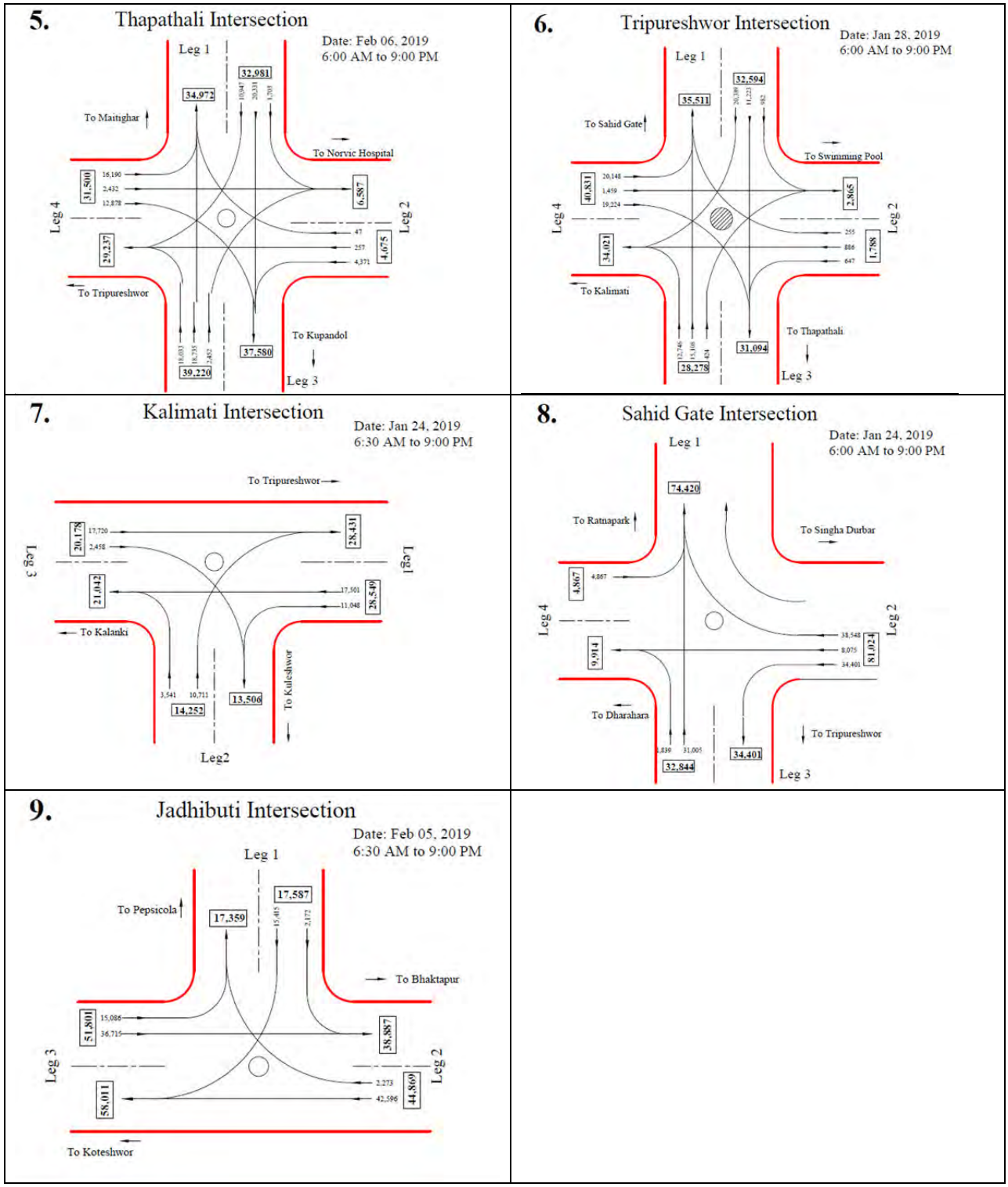
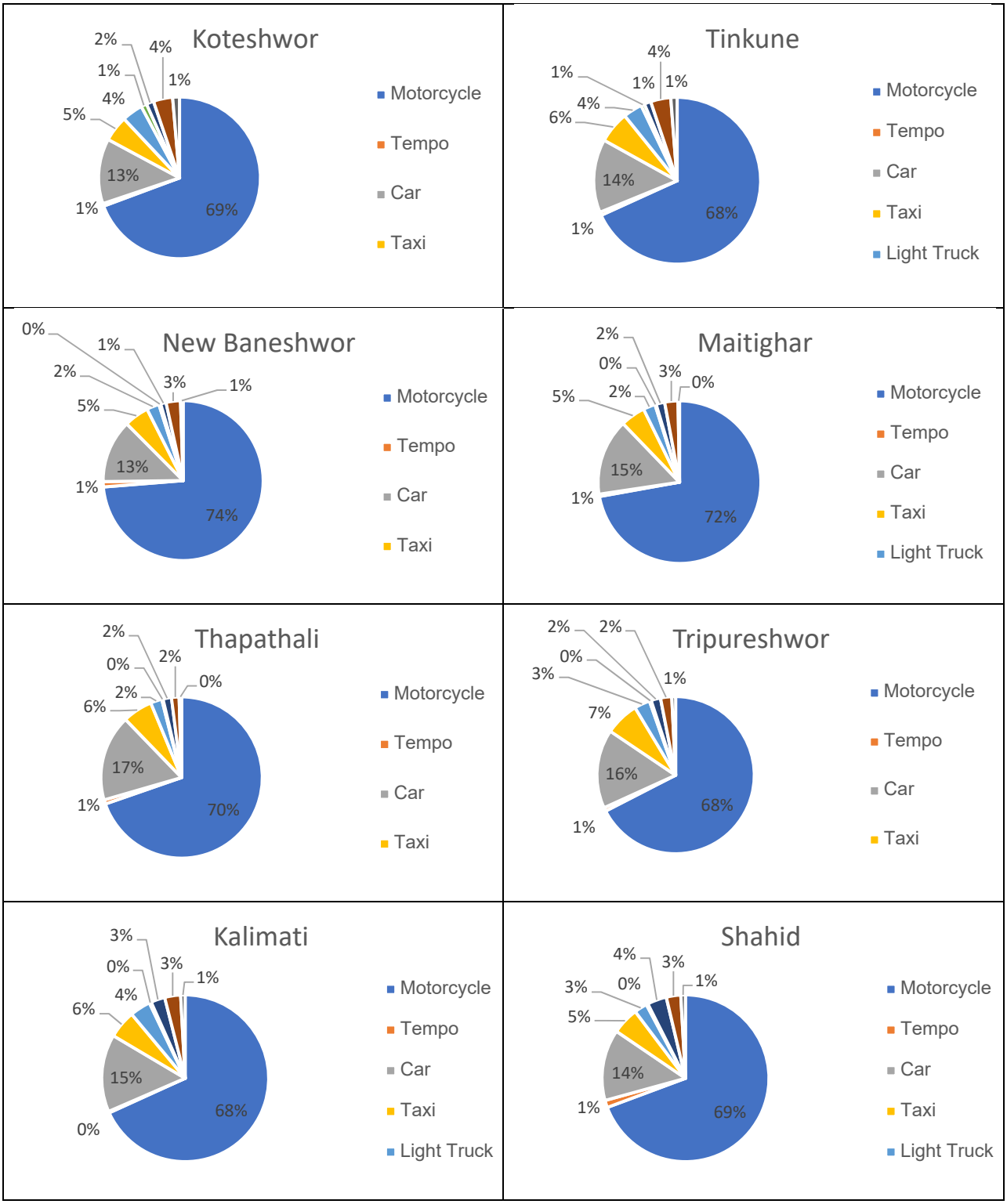


Figure 4.2 Directional Traffic Volumes at Intersections

(2) Vehicle Count Share



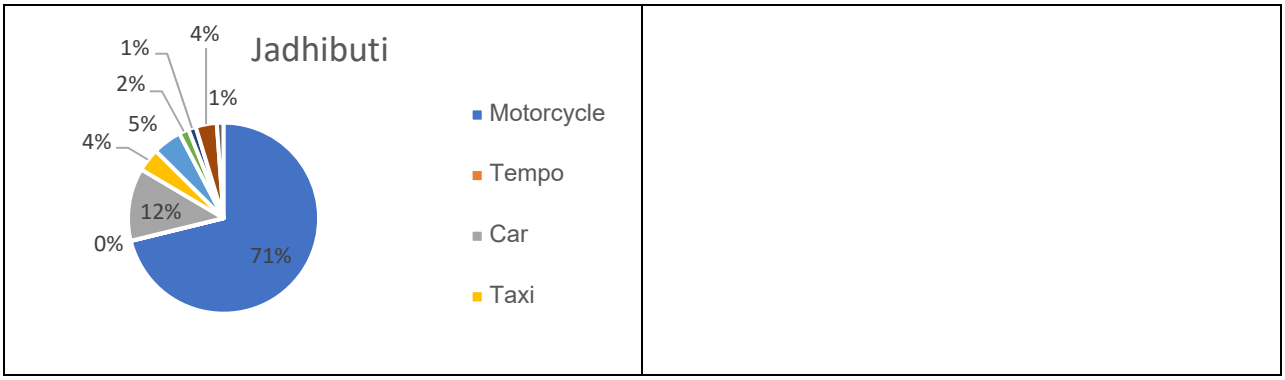
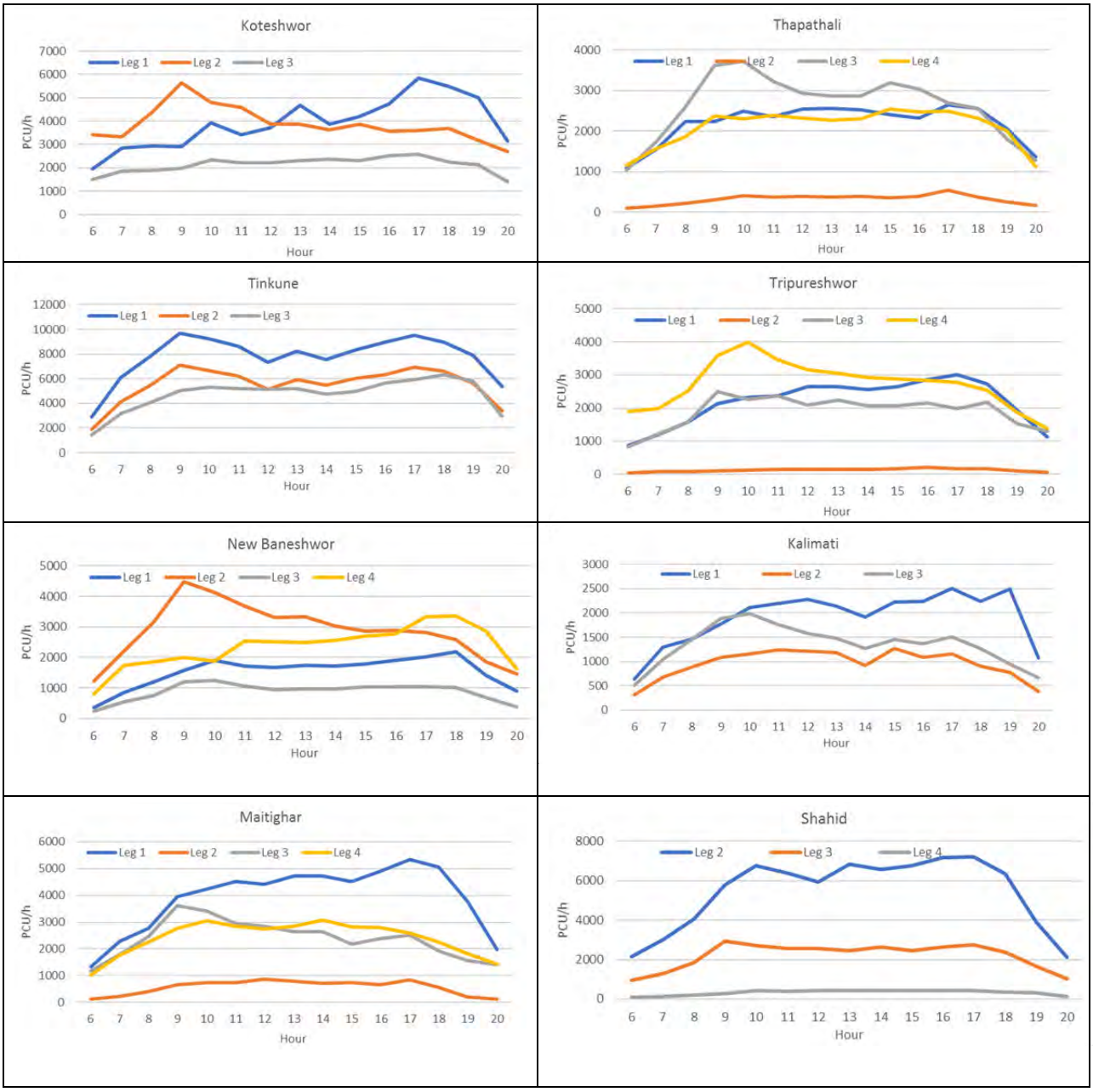


Figure 4.3 Vehicle Count Share at Intersections

(3) Hourly Traffic Volume (PCU/Hour)



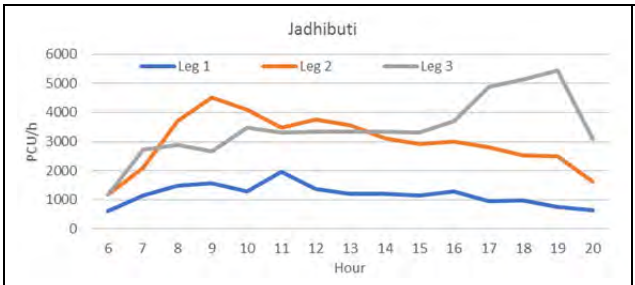


Figure 4.4 Hourly Traffic Volumes at Intersections

Table 4.1 Summary of Traffic Volume Data (PCU/Day)

Intersection	Leg	Direction	Observed PCU	Hours	24H converted PCU
Koteshwor	1	in	58,675	15	64,543
Koteshwor	1	out	59,706	15	65,677
Koteshwor	2	in	58,144	15	63,958
Koteshwor	2	out	58,216	15	64,038
Koteshwor	3	in	31,910	15	35,101
Koteshwor	3	out	30,807	15	33,888
Tinkune South	1	in	26,493	14.5	29,234
Tinkune South	1	out	23,401	14.5	25,822
Tinkune South	2	in	57,182	14.5	63,097
Tinkune South	2	out	55,646	14.5	61,402
Tinkune South	3	in	3,291	14.5	3,631
Tinkune South	3	out	3,208	14.5	3,540
Tinkune South	4	in	29,708	14.5	32,781
Tinkune South	4	out	34,377	14.5	37,933
Tinkune West	1	in	9,137	14.5	10,082
Tinkune West	1	out	11,932	14.5	13,166
Tinkune West	2	in	34,361	14.5	37,916
Tinkune West	2	out	29,616	14.5	32,680
Tinkune West	3	in	39,454	14.5	43,535
Tinkune West	3	out	41,404	14.5	45,687
Tinkune North	1	in	35,596	14.5	39,278
Tinkune North	1	out	35,297	14.5	38,948
Tinkune North	2	in	23,382	14.5	25,801
Tinkune North	2	out	26,470	14.5	29,208
Tinkune North	3	in	11,915	14.5	13,148
Tinkune North	3	out	9,126	14.5	10,070
New Baneshwor	1	in	22,919	14.5	25,290
New Baneshwor	1	out	19,894	14.5	21,952
New Baneshwor	2	in	43,065	14.5	47,520
New Baneshwor	2	out	42,924	14.5	47,364
New Baneshwor	3	in	13,199	14.5	14,564

Intersection	Leg	Direction	Observed PCU	Hours	24H converted PCU
Maitighar	3	out	39,987	14.75	44,053
Maitighar	4	in	36,098	14.75	39,769
Maitighar	4	out	44,124	14.75	48,611
Maitighar	5	Out	22,233	14.75	24,494
Thapathali	1	in	32,981	15	36,279
Thapathali	1	out	34,972	15	38,469
Thapathali	2	in	4,675	15	5,143
Thapathali	2	out	6,587	15	7,246
Thapathali	3	in	39,220	15	43,142
Thapathali	3	out	37,580	15	41,338
Thapathali	4	in	31,500	15	34,650
Thapathali	4	out	29,237	15	32,161
Tripureshwor	1	in	32,594	15	35,853
Tripureshwor	1	out	35,511	15	39,062
Tripureshwor	2	in	1,788	15	1,967
Tripureshwor	2	out	2,865	15	3,152
Tripureshwor	3	in	28,278	15	31,106
Tripureshwor	3	out	31,094	15	34,203
Tripureshwor	4	in	40,831	15	44,914
Tripureshwor	4	out	34,021	15	37,423
Kalimati	1	in	28,549	14.5	31,502
Kalimati	1	out	28,431	14.5	31,372
Kalimati	2	in	14,252	14.5	15,726
Kalimati	2	out	13,506	14.5	14,903
Kalimati	3	in	20,178	14.5	22,265
Kalimati	3	out	21,042	14.5	23,219
Shahid Gate	1	out	74,420	15	81,862
Shahid Gate	2	in	81,024	15	89,126
Shahid Gate	3	in	32,844	15	36,128
Shahid Gate	3	out	34,401	15	37,841
Shahid Gate	4	in	4,867	15	5,354

New Baneshwor	3	out	13,679	14.5	15,094
New Baneshwor	4	in	35,041	14.5	38,666
New Baneshwor	4	out	37,727	14.5	41,630
Maitighar	1	in	58,467	14.75	64,413
Maitighar	1	out	22,378	14.75	24,654
Maitighar	2	in	8,348	14.75	9,197
Maitighar	2	out	9,701	14.75	10,688
Maitighar	3	in	35,510	14.75	39,121

Shahid Gate	4	out	9,914	15	10,905
Jadhibuti	1	in	17,587	14.5	19,406
Jadhibuti	1	out	17,359	14.5	19,155
Jadhibuti	2	in	44,869	14.5	49,511
Jadhibuti	2	out	38,887	14.5	42,910
Jadhibuti	3	in	51,801	14.5	57,160
Jadhibuti	3	out	58,011	14.5	64,012

Appendix 5 Geological Survey

APPENDIX 5 GEOLOGICAL SURVEY

The result of geological survey is described from the following page.

Report on

Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

JICA Study Team Joint Venture of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

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Prepared For

Oriental Consultants Global Co., Ltd.
Kathmandu, Nepal

Prepared By

Pashupati Drilling & Geo- Technical Services Pvt. Ltd.
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E-mail: pashupatidrilling@gmail.com

May 2019

Final Investigation Quantity

Plan of boring: 50m × 5boreholes = 250m

No.	Item	Unit	Quantity	Remarks
A	**Mobilization & Demobilization**			
A1	Mobilization & Demobilization	LS	1	
B	**Rotary Mchine Boring**			
B1	Boring 0～10m	meter	50	
B2	Boring 10～20m	meter	50	
B3	Boring 20～30m	meter	50	
B4	Boring 30～40m	meter	50	
B5	Boring 40～50m	meter	50	
B6	Water lever measuring in borehole	nos.	5	
C	**Field testing and sampling**			
C1	Standard Penetration Test	nos.	250	1.0m interval
C2	Undisturbed (UD) Sampling	samples	24	
C3	Methane Concentration test	nos.	5	
D	**Laboratory Testing**			
D1	Natural Moisture Content	nos.	54	
D2	Specific Gravity	nos.	54	
D3	Plastic Limit	nos.	26	
D4	Liquid Limit	nos.	26	
D5	Sieve Analysis	nos.	54	
D6	Hydrometer test	nos.	34	
D7	Unconfined compressive strength	nos.	16	for undisturbed samples
D8	One-dimensional consolidation	nos.	24	for undisturbed samples
D9	Direct shear test	nos.	24	for undisturbed samples
E	**Reporting**			
E1	Reporting	Ls	1	3 hard copies & 1 CD
F	**Survey Related Cost**			
F1	Accommodation	sites	5	
F2	Security	sites	5	
F3	Daily transportation at site	sites	5	

Contents

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

Geological Survey Under Data Collection Survey
on
Urban Transport in Kathmandu Valley

1. GENERAL INTRODUCTION & BACKGROUND

JICA Study Team for the Data Collection Survey on Urban Transport in Kathmandu Valley in the Federal Democratic Republic of Nepal, a Joint Venture of Oriental Consultants Global Co. Ltd., and PADECO Co., LTD; represented by Oriental Consultants Global Co. Ltd., a corporation duly organized and existing under the laws of Japan is intended to acquire and collect the geotechnical information necessary for road intersection improvement and implementation of future track traffic project through "Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley".

The study were carried out in three (3) sites (Tinkune Park, Baneshwor & Tripureshwor) for road intersection improvement project and two (2) sites (Manohara & Tundikhel) for track traffic project are planned in the survey respectively.

Here a short geotechnical investigation program for soil parameters and strata have been attempted to determine the safety assessment of newly constructing structures. This program included both the field and laboratory investigation in order to get reliable information on:

a) General information of the site.

b) The stratification of sub soil.

c) The soil parameter for design of structures.

2. GENERAL GEOLOGY, GEOMORPHOLOGY

The Kathmandu Valley is an ultramontane basin located in the Lesser Himalayan region in Central Nepal. Bedrocks are exposed mainly in the hill slopes around the basin and only at few places in the valley floor. The Valley is filled with the fluvio-lacustrine sediments of Quaternary age. These sediments were derived from the surrounding hills. The thickness of the valley fill sediments varies according to the undulated pattern of the basement (from 78 m in Bansbari up to 549m in Bhrikuti Mandap as confirmed by deep bore holes (HMG/UNDP/UNCHS, 1994). The thickness of the valley fill sediments also varies according to the undulated pattern of the basement.

As a matter of fact, all the project sites are in a flat area which is formed by lacustrine deposits with clayey silts, sandy silts, silty sands and sands with fine gravels are found in their textures in the vicinity of the sites. The deposits are in soft to very stiff and loose to very dense in state respectively.

Moreover, the different data of epicenter and magnitude of the historical earthquakes shows that Nepal is located on high seismic zones. However, for these sites from the figure of seismicity map of Nepal (attached in *annexes*) lies relatively in the risky zone from the past seismic records and whereas the MCT lies far from the site locations. The epicentral distance is nearer from minor to major earthquakes. So, we may conclude that the proposed sites should be made safe from the devasting earthquake.

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3. SCOPE OF WORK

The scope of work includes drilling of five (5) nos. of boreholes having 50.0m depths in different location of Kathmandu Valley with standard penetration test, retrieving samples from the boreholes to get the geological information based on field and laboratory test results.

4. METHODOLOGY

4.1 Field Work Procedure

Field works involved Rotary Drilling Method for drilling and sampling of the boreholes inside the project area where it was applicable to the maximum depth of 50.0m from the ground levels and SPT observations were taken at every 1.0m intervals and are recorded. Borehole logs were prepared at the site on the basis of the visual observation of the soil obtained from the boreholes. The bore hole logs are attached to the ***annexes*** are verified by lab test results.

Method of Drilling

Rotary Drilling Method (IS : 6926-1973):-

Rotary Hydraulic Drilling Machine (VOLTAS JOY 12- Junior) is used for drilling bore holes by rotating the diamond core bit fixed at the lower end of the drill rod i.e. barrel with drilling fluid; water or bentonite slurry. This method is adopted in the project area because of the presence of soft cohesive soils and loose cohesionless soil layers in the vicinity of the sites and also the method is accurate than other drilling methods.

The NX Series drilling system was used for the drilling works in all project location areas.

4.1.1 In-situ Tests

Standard Penetration Test (SPT) ASTM D 1586: It consists of driving a Split Spoon sampler with an outside dia. of 50mm into the soil at the base of borehole. Driving is accomplished by a drop of hammer weighing 63.5 kg falling freely through a height of 750 mm onto the drive head. First of all the spoon is driven 150mm into the soil at the bottom of the borehole. It is then driven further 300mm in each 100mm interval with three successive blow counts that gives the number of blows (N values).

The field values of SPT (N) are mentioned in the attached log sheets.

4.1.2 Sampling

(i) Disturbed Sample:

Before any sample was taken, the boreholes were cleaned up of loose disturbed soil deposited during drilling operation. The samples that were obtained from barrel and the SPT tubes were preserved as representative disturbed samples for finding out physical properties. The samples thus obtained were placed in airtight double plastic bags, labeled properly for identification and later transported to the laboratory for analysis.

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(ii) Undisturbed Sample:

The undisturbed soil samples were taken effectively at different depths in each bore holes due to the presence of plastic clayey soils by using thin walled sampler, which are shown in the bore hole logs in the ***annexes***.

4.1.3 Methane (CH_4) Gas Test

Field works also include the Methane (CH_4) Gas Test of the boreholes inside the project area to the maximum depth of 50.0m from the ground levels. The Gas Analyzer.: Biogas 5000 Geotech machine is used to test the bore holes by mining experts. The recorded values attached to the ***annexes***.

4.1.4 Geodetic Measurement of the Drilling Works

The geodetic measurements are observed of each drilling points of the project sites for retrieving the coordinate data with elevation using Static GPS method.

The complete geodetic survey report is attached in the ***annexes***.

5. LABORATORY TESTS

The samples of each changed stratum have taken for the laboratory tests after logging of bore holes. Following laboratory tests are could be recommended for the retrieved soil samples to get the physical and strength properties of the sub soil, as per IS & ASTM standards code of practice.

a) Grain Size Distribution Analysis
b) Atterberg's Limit
c) Natural Moisture Contents,
d) Bulk & Dry Density
e) Specific Gravity Tests
f) Direct Shear Tests
g) Consolidation Tests and,
h) Unconfined Compression Tests

Detail laboratory test results are presented in the ***annexes*** with USCS Soil Classification system .

6. ANALYSIS OF SOIL EXPLORATION

6.1 Strata

All bore hole locations are taken in flat area of naturally deposited soils formed by lacustrine deposits. Briefly the soil profiles are describes in the Bore Hole Logs in the ***annexes*** as per USCS Soil Classification System.

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6.2 Moisture Content and Density

The natural moisture contents are found lower to higher in cohesive to semi-cohesive and semi-cohesionless to cohesionless soil layers; that give lower to medium voids with soft to very stiff and loose to very dense in state respectively.

6.3 Water Level

During the field investigation water table was observed after 24 hrs, the completion of each borehole. The seepage ground water levels were found in all bore holes as follows :

Bore Hole No.	Location	Depth of Water Level (m)
BH - 01	Manahara, Kathmandu, Nepal	2.5
BH - 02	Tinkune Park, Kathmandu, Nepal	5.5
BH - 03	New Baneshwor, Kathmandu, Nepal	7.5
BH - 04	Tundikhel, Kathmandu, Nepal	6.0
BH - 05	Tripureshwor, Kathmandu, Nepal	5.5

7. RESULTS & DISCUSSION

The sub-soil strata with field observations are mentioned in the bore hole log in the ***annexes***. Thus, based on field and laboratory tests following inferences have been made.

Manohara (BH-01)

i) The soils are found medium to very dense sandy soils in upper layer 35m depth and below that depth stiff to very stiff plastic clayey silts are encountered to the depth of 50.0m respectively.

ii) The natural moisture content, dry density and the specific gravity of clayey soil shows the soils are free from organic contents and the methane gas (CH_4) is observed 4.7%.

iii) The liquefaction susceptibility could be seen upto 3.0m depth due to loose to medium dense silty sands.

Tinkune Park (BH-02)

i) The medium dense sandy layers are seen upto 15.5m depth, below that depth to 50.0m depth stiff to very stiff plastic clayey silt layers are seen.

ii) The moisture content, dry density and the specific gravity of clayey soils shows, the soil contains lower organic contents.

iii) The shear and compressibility parameters shows the soils are in medium strength.

iv) Due to the loose to medium dense sands with little amount of fines the soils could be liquefy upto 7.0m depth.

v) The concentration of methane gas (CH_4) is found 9.2% at the project site area.

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New Baneshwor (BH-03)

i) The medium to dense sandy soils with thin stiff clayey stratum are found upto 18.5m depth and below that depth stiff plastic clayey layer are seen upto 50.0m depth of investigation.

ii) The natural moisture content, specific gravity and dry density values shows the presence of organic contents in lower amount.

iii) The shear and settlement parameter values shows the soil are in medium strength and compressibility nature respectively.

iv) The observed value of methane gas (CH_4) in the project site is 0.7%.

v) The liquefaction susceptibility could not be seen to the project site due to the medium denseness of sandy soils.

Tundikhel (BH-04)

i) The medium to very dense sandy soils are found in upper layers upto 7.0m depth, beyond that depths to 50.0m of investigation soft to stiff plastic clayey silts were seen.

ii) The natural moisture, dry density and specific gravity values show there would be the presence of organic contents in the clayey soil layers.

iii) The shear and settlement values shows the soils are in lower to medium strength with medium compressibility.

iv) The observed value of methane gas (CH_4) in the project site is 17.6%.

v) The liquefaction susceptibility could not be seen in the project site although there is the presence of sandy soils.

Tripureshwor (BH-05)

i) In this site upto 8.5m depth sandy soils are found with loose to very dense in state and then soft to stiff plastic clayey silts were seen upto 50.0m depth of investigation.

ii) The specific gravity and dry density values shows that the clayey soils in the greater depth should have the percentage of organic contents. The natural moisture contents are also found medium to higher.

iii) The soils seem lower strength with medium compressibility.

iv) The presence of methane gas (CH_4) in the project site is found 58.4%.

v) Due to the loose state of sandy soils upto 3.0m depth liquefaction susceptibility could be seen.

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8. RECOMMENDATION

i) The temporary support system should have provided during the excavation period.

ii) The dewatering system must be addresses during the excavation of trenches/pits.

iii) The frost action is negligible in the whole study area.

iv) The heaving action could be seen in clayey soil layers if it is excavated.

v) The load bearing capacity of the soils could be found minimum for shallow depths and spread and mat foundations.

vi) The frictional pile foundation works could be considered for the heavy loaded structure in Tundikhel (BH-04) and Tripueshwor (BH-05) project site whereas rest of the sites could be used end bearing oiles for the same work.

vii) Mostly the soils are found in soft soils.

viii) The concentration of methane gas (CH_4) at Tripureshwor and Tundikhel site has found remarkable whereas in other three (3) sites, it seems in lower side respectively. The emission rate of gas seems very low amount and there has no any explosion record in Mining Division, Lainchour, Nepal during the sub-surface excavation and boring/drilling period. But we have to take precaution during the excavation period below the sandy zone in that project site area.

ix) The artesian aquifer was not found in all bore holes.

x) The peizometric seepage water was seen in upper surface layers in all bore holes respectively.

xi) The clayey soils were encountered in all bore holes having higher percentage of silt fraction.

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ANNEXES –

A. **Site Map**

B. **Bore Hole Logs**

C. **Design Parameters**

D. **Laboratory Test Result Summary Sheets**

E. **Methane Gas Test Results**

F. **Geodetic Survey Report**

G. **Figure**

H. **Photographs**

ANNEX - A

SITE MAP


[Legends]
Survey Site for Road Project
Survey Site for Track Traffic project
BH-05
L=50m
BH-04
L=50m
BH-03
L=50m
BH-02
L=50m
BH-01
L=50m
KAPAN
Manohara
Swayambhunath Stupa
Kathmandu
Kathmandu Durbar Square
Ratna Park
KALIMATI
TEKU
SINAMANGAL
NEW BANESHWOR
Changunarayan
Tribhuvan University
SANEPA
Madhyapur Thimi
JAWALAKHEL
Patan Durbar Square
Bhaktapur
Kirtipur
Patan
Ring Road
Araniko Highway
Satellite
Google
Map data ©2018 Google
Japan
Terms
Send feedback
1 km

ANNEX - B
BORE HOLE LOGS

BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Manahara, Kathmandu, Nepal **Position :** 634882.4 E, 3063828 N

Bore Hole No.: BH - 01 **Reduced Level (m)** : 1299.17

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
0							SPT								0
1		2.0		SM	Brownish loose non plastic silty sands with fine gravels		1.0	2	1	2	2	5	**5**		1
2	2.0						2.0	2	3	3	4	10	**10**		2
3						2.5	3.0	4	4	5	6	15	**15**		3
4							4.0	7	7	10	11	28	**28**		4
5							5.0	6	7	9	13	29	**29**		5
6		8.0		SM	Dark grayish medium to dense silty sands		6.0	8	10	14	12	36	**36**		6
7							7.0	10	9	11	12	32	**32**		7
8							8.0	8	10	11	13	34	**34**		8
9							9.0	9	10	13	18	41	**41**		9
10	10.0						10.0	7	8	11	20	39	**39**		10

*** Maximum SPT Value.**

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Continue …

BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Manahara, Kathmandu, Nepal **Position :** 634882.4 E, 3063828 N

Bore Hole No.: BH - 01 **Reduced Level (m)** : 1299.17

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
10							SPT								10
11							11.0	8	10	11	15	36	36		11
12		4.5		SP	Grayish dense to very dense poorly graded sands with little amount of fines		12.0	9	12	14	18	44	44		12
13							13.0	12	13	14	19	46	46		13
14	14.5						14.0	14	15	17	21	53	≥50*		14
15							15.0	4	6	7	10	23	23		15
16		2.5		SM	Gray blackish medium dense slight plastic silty sands		16.0	6	9	8	12	29	29		16
17	17.0						17.0	5	7	9	11	27	27		17
18		2.0		ML	Gray blackish very stiff low plastic clayey silts with appreciable amount of fine sands		18.0	6	8	10	12	30	30		18
19	19.0						19.0	8	12	12	15	39	39		19
20				SW - SM	Grayish dense to very dense poorly to well graded sands with fines		20.0	13	17	15	15	47	47		20

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Manahara, Kathmandu, Nepal **Position :** 634882.4 E, 3063828 N

Bore Hole No.: BH - 01 **Reduced Level (m)** : 1299.17

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
20															20
	21.0	2.0		SW - SM	Grayish dense to very dense poorly to well graded sands with fines		SPT 21.0	17	11	10	14	35	35		
21															21
							22.0	17	9	10	9	28	28		
22															22
							23.0	15	10	9	13	32	32		
23															23
		6.0		SM	Grayish dense to very dense silty sands		24.0	10	12	15	24	51	≥50*		
24															24
							25.0	14	14	13	21	48	48		
25															25
							26.0	10	9	10	16	35	35		
26															26
	27.0														
27							27.0	12	10	10	15	35	35		27
		2.0		SM	Gray blackish dense slight plastic silty sands		28.0	9	9	11	14	34	34		
28															28
	29.0														
29							29.0	12	13	13	16	42	42		29
				SM	Gray brownish dense to very dense silty sands										
30							30.0	11	10	10	15	35	35		30

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

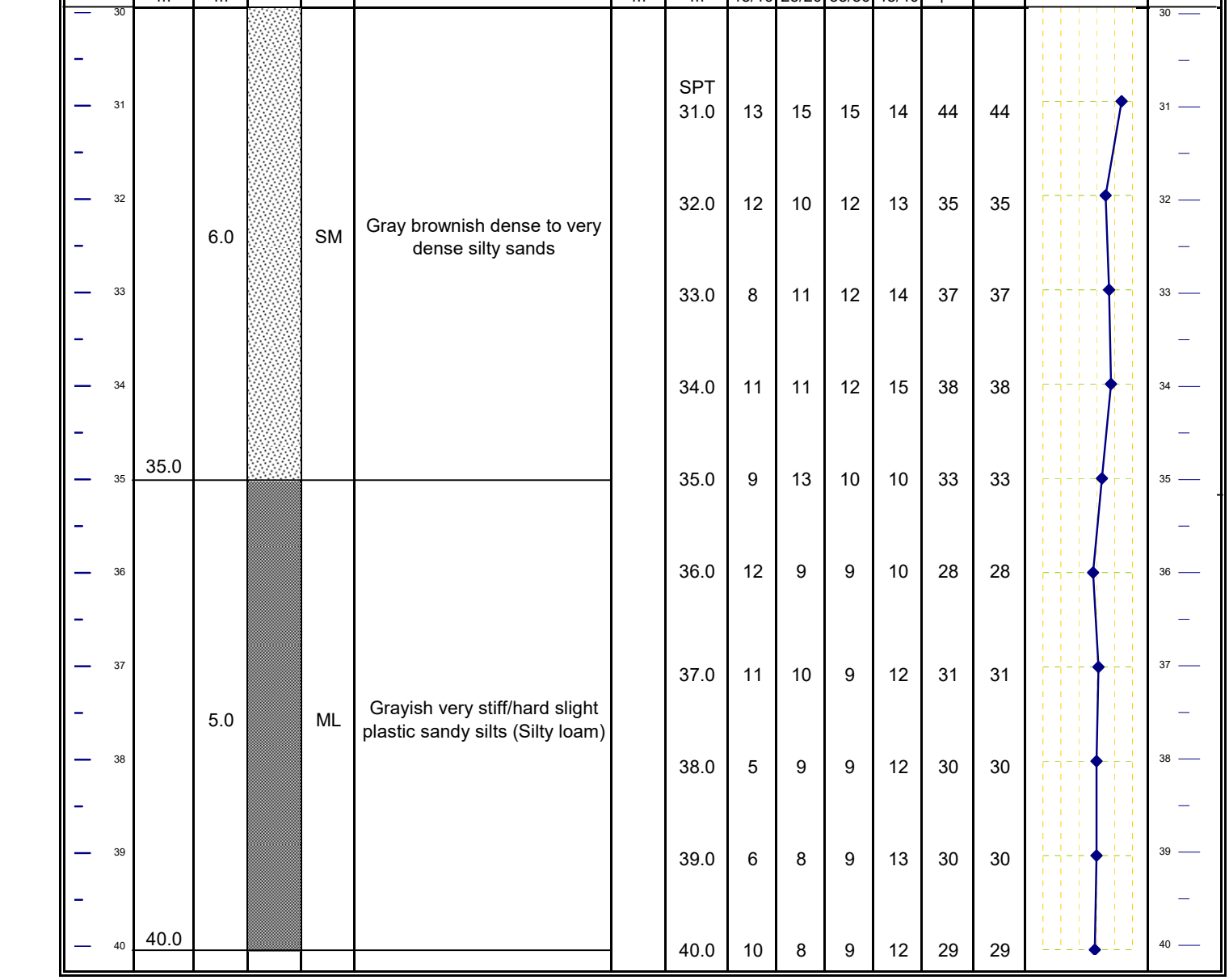
Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Manahara, Kathmandu, Nepal **Position :** 634882.4 E, 3063828 N

Bore Hole No.: BH - 01 **Reduced Level (m)** : 1299.17

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
30															30
31							SPT 31.0	13	15	15	14	44	44		31
32		6.0		SM	Gray brownish dense to very dense silty sands		32.0	12	10	12	13	35	35		32
33							33.0	8	11	12	14	37	37		33
34							34.0	11	11	12	15	38	38		34
35	35.0						35.0	9	13	10	10	33	33		35
36							36.0	12	9	9	10	28	28		36
37		5.0		ML	Grayish very stiff/hard slight plastic sandy silts (Silty loam)		37.0	11	10	9	12	31	31		37
38							38.0	5	9	9	12	30	30		38
39							39.0	6	8	9	13	30	30		39
40	40.0						40.0	10	8	9	12	29	29		40



*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Manahara, Kathmandu, Nepal **Position :** 634882.4 E, 3063828 N

Bore Hole No.: BH - 01 **Reduced Level (m)** : 1299.17

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	Total SPT Value	SPT 0 10 20 30 40 50	Scale
40															40
	UD 40.5						SPT								
41							41.0	8	5	6	8	19	19		41
42							42.0	6	6	8	8	22	22		42
43		6.0		ML	Grayish very stiff low plastic clayey silts with little amount of sands		43.0	6	6	7	10	23	23		43
44							44.0	7	9	9	10	28	28		44
45							45.0	10	8	8	11	27	27		45
46	46.0						46.0	9	10	10	13	33	33		46
47							47.0	10	8	10	11	29	29		47
48		4.5		ML	Gray blackish very stiff/hard slight plastic sandy silts (Silty loam)		48.0	14	9	10	12	31	31		48
	UD 48.5														
49							49.0	12	7	11	13	31	31		49
50	50.5						50.0	10	6	8	14	28	28		50

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tinkune Park, Kathmandu, Nepal **Position :** 633307.9 E, 3063545 N

Bore Hole No.: BH - 02 **Reduced Level (m)** : 1296.711

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
0							SPT								0
1							1.0	17	9	9	12	30	**30**		1
2		4.0		SM	Gray brownish medium dense siltysands with gravels and 40cm thick clayey silt layers at 3.20mdepth		2.0	15	10	9	11	30	**30**		2
3							3.0	8	3	3	3	9	**9**		3
4	4.0						4.0	7	6	6	8	20	**20**		4
5		1.5		ML	Gray very stiff slight plastic clayey silts with fine sands		5.0	8	8	7	9	24	**24**		5
	5.5					5.5									
6		1.5		SW	Brownish medium dense well graded sands with fine gravels		6.0	6	5	6	4	15	**15**		6
7	7.0						7.0	6	4	6	6	16	**16**		7
8		3.0		SM	Grayish medium dense silty sands with little amount of fine gravels		8.0	7	5	5	6	16	**16**		8
9							9.0	10	6	7	10	23	**23**		9
10	10.0						10.0	6	6	8	9	23	**23**		10

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tinkune Park, Kathmandu, Nepal **Position :** 633307.9 E, 3063545 N

Bore Hole No.: BH - 02 **Reduced Level (m)** : 1296.711

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
10															10
11		2.0		SW	Grayish medium dense well graded sands with fine gravels		SPT 11.0	7	9	9	11	29	29		11
12	12.0						12.0	6	5	9	11	25	25		12
13							13.0	5	5	7	9	21	21		13
14		3.5		SM	Grayish medium dense non plastic silty sands with little amount of fine gravels		14.0	6	5	11	10	26	26		14
15	15.5						15.0	7	7	10	12	29	29		15
16							16.0	5	5	6	6	17	17		16
17							17.0	6	5	4	6	15	15		17
18				ML	Grayish stiff to very stiff slight plastic clayey silts with fine sands		18.0	4	4	5	6	15	15		18
19							19.0	6	6	5	7	18	18		19
20							20.0	6	5	6	6	17	17		20

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tinkune Park, Kathmandu, Nepal **Position :** 633307.9 E, 3063545 N

Bore Hole No.: BH - 02 **Reduced Level (m)** : 1296.711

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
20															20
21							SPT 21.0	5	4	5	6	15	15		21
22	***UD 22.5***	9.5		ML	Grayish stiff to very stiff slight plastic clayey silts with fine sands		22.0	5	5	5	7	17	17		22
23							23.0	7	6	6	8	20	20		23
24							24.0	5	5	5	4	14	14		24
25	25.0						25.0	5	4	4	5	13	13		25
26		3.0		ML	Gray blackish stiff to very stiff low plastic clayey silts with fine sands		26.0	5	6	6	7	19	19		26
27							27.0	6	6	5	6	17	17		27
28	28.0						28.0	6	4	4	4	12	12		28
29				ML	Gray blackish stiff low plastic clayey silts with fine sands		29.0	5	6	4	5	15	15		29
30							30.0	5	4	4	5	13	13		30

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tinkune Park, Kathmandu, Nepal **Position :** 633307.9 E, 3063545 N

Bore Hole No.: BH - 02 **Reduced Level (m)** : 1296.711

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
30															30
							SPT								
31							31.0	4	5	4	4	13	13		31
	UD														
	31.5														
32							32.0	5	4	4	6	14	14		32
33							33.0	4	4	4	5	13	13		33
34							34.0	4	5	6	6	17	17		34
		12.0		ML	Gray blackish stiff low plastic clayey silts with fine sands										
35							35.0	5	5	5	6	16	16		35
36							36.0	7	6	6	7	19	19		36
37							37.0	6	7	6	6	19	19		37
38							38.0	5	5	6	6	17	17		38
39							39.0	6	5	5	6	16	16		39
	UD														
	39.5														
40	40.0						40.0	7	7	6	6	19	19		40

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tinkune Park, Kathmandu, Nepal **Position :** 633307.9 E, 3063545 N

Bore Hole No.: BH - 02 **Reduced Level (m)** : 1296.711

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
40															40
41							SPT 41.0	5	6	8	7	21	21		41
42							42.0	7	6	6	7	19	19		42
43							43.0	5	7	6	7	20	20		43
44							44.0	5	6	6	6	18	18		44
45		10.5		ML	Gray blackish very stiff low plastic clayey silts with fine sands		45.0	6	7	6	6	19	19		45
	UD 45.5														
46							46.0	5	5	6	7	18	18		46
47							47.0	5	6	5	6	17	17		47
48							48.0	7	6	7	7	20	20		48
49							49.0	6	6	7	6	19	19		49
50	50.5						50.0	7	6	6	7	19	19		50

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: New Baneshwor, Kathmandu, Nepal **Position :** 631860 E, 3063972 N

Bore Hole No.: BH - 03 **Reduced Level (m)** : 1305.686

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
0															0
1	1.5	1.5		ML	Yellow brownish stiff slight plastic clayey silts with fine sands		SPT 1.0	4	5	4	4	13	**13**		1
2							2.0	7	7	7	8	22	**22**		2
3		2.5		ML - SM	Brownish medium dense non plastic silty sands (Sandy loam)		3.0	5	4	6	8	18	**18**		3
4	4.0						4.0	11	10	8	7	25	**25**		4
5	5.5	1.5		SP	Whitish medium dense poorly graded sands		5.0	8	10	9	8	27	**27**		5
6							6.0	3	4	4	6	14	**14**		6
7	7.5	2.0		ML	Gray blackish medium to stiff slight to low plastic clayey silts with appreciable amount of fine sands		7.0	2	3	2	2	7	**7**		7
8						7.5	8.0	23	35	50/4.0	-	-	**≥50***		8
9				SM	White brownish dense to very dense silty sands		9.0	12	15	17	27	59	**≥50***		9
10							10.0	11	13	18	20	51	**≥50***		10

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: New Baneshwor, Kathmandu, Nepal **Position :** 631860 E, 3063972 N

Bore Hole No.: BH - 03 **Reduced Level (m)** : 1305.686

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	Total SPT Value	SPT 0 10 20 30 40 50	Scale
10															10
11		4.0		SM	White brownish dense to very dense silty sands		SPT 11.0	7	8	11	16	35	35		11
	11.5														
12		1.5		ML	Gray blackish stiff low plastic clayey silts with fine sands		12.0	2	3	3	4	10	10		12
	13.0														
13		1.5		SP	Grayish medium dense poorly graded sands		13.0	6	6	7	9	22	22		13
14	14.5						14.0	7	6	8	8	22	22		14
15		2.5		SP	Whitish medium dense poorly graded sands		15.0	4	7	9	13	29	29		15
16							16.0	5	8	8	11	27	27		16
	17.0														
17		1.5		SM	Gray blackish medium to dense silty sands		17.0	8	10	9	11	30	30		17
18	18.5						18.0	9	9	11	12	32	32		18
19				ML	Gray blackish stiff slight plastic clayey silts with appreciable amount of fine sands		19.0	2	3	3	5	11	11		19
20							20.0	2	2	4	6	12	12		20

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: New Baneshwor, Kathmandu, Nepal **Position :** 631860 E, 3063972 N

Bore Hole No.: BH - 03 **Reduced Level (m)** : 1305.686

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
20															20
		3.0		ML	Gray blackish stiff slight plastic clayey silts with appreciable amount of fine sands		SPT								
21	21.0						21.0	2	2	2	3	7	7		21
22							22.0	1	2	3	2	7	7		22
	UD														
	22.5														
23		4.0		ML	Gray blackish stiff low plastic clayey silts with fine sands		23.0	3	3	3	4	10	10		23
24							24.0	3	2	3	3	8	8		24
25	25.0						25.0	3	5	4	4	13	13		25
	UD														
	25.5														
26							26.0	4	5	5	6	16	16		26
27							27.0	3	3	5	6	14	14		27
				ML	Gray blackish stiff low to medium plastic clayey silts with little amount of fine sands										
28							28.0	4	3	5	5	13	13		28
29							29.0	4	4	5	4	13	13		29
30							30.0	5	4	4	6	14	14		30

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: New Baneshwor, Kathmandu, Nepal **Position :** 631860 E, 3063972 N

Bore Hole No.: BH - 03 **Reduced Level (m)** : 1305.686

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
30							SPT								30
31							31.0	3	3	3	4	10	10		31
32							32.0	4	2	3	3	8	8		32
33		12.0		ML	Gray blackish stiff low plastic clayey silts with little amount of fine sands		33.0	3	2	2	2	6	6		33
34							34.0	4	2	2	3	7	7		34
35	***UD 34.5***						35.0	1	2	3	3	8	8		35
36							36.0	1	1	2	3	6	6		36
37	37.0						37.0	4	6	4	5	15	15		37
38				ML	Gray blackish stiff low plastic clayey silts with fine sands		38.0	5	4	4	4	12	12		38
39	***UD 39.5***						39.0	6	4	5	5	14	14		39
40							40.0	5	4	4	3	11	11		40

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: New Baneshwor, Kathmandu, Nepal **Position :** 631860 E, 3063972 N

Bore Hole No.: BH - 03 **Reduced Level (m)** : 1305.686

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
40															40
41							SPT 41.0	2	3	5	4	12	12		41
42		7.5		ML	Gray blackish stiff low plastic clayey silts with fine sands		42.0	1	2	5	5	12	12		42
43	***UD 43.5***						43.0	6	5	4	6	15	15		43
44	44.5						44.0	6	4	5	5	14	14		44
45							45.0	4	3	3	3	9	9		45
46							46.0	4	2	3	4	9	9		46
47	***UD 47.5***	6.0		ML	Gray blackish stiff low plastic clayey silts with little amount of fine sands		47.0	5	4	4	4	12	12		47
48							48.0	4	3	5	5	13	13		48
49							49.0	7	5	6	5	16	16		49
50	50.5						50.0	6	5	5	6	16	16		50

*** Maximum SPT Value.**

Pashupati Drilling & Geo- Technical Services Pvt. Ltd.

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tundikhel, Kathmandu, Nepal **Position :** 629882.5 E, 3065788 N

Bore Hole No.: BH - 04 **Reduced Level (m)** : 1298.592

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
0							SPT								0
1		1.5		SM	Brownish medium dense silty sands with gravels, brickbats etc. (Filling materials)		1.0	4	4	3	4	11	**11**		1
	1.5														
2							2.0	4	5	4	4	13	**13**		2
3		3.5		SM	White brownish medium to dense silty well graded sands with little amount of fine gravels		3.0	6	5	9	9	23	**23**		3
4							4.0	14	11	12	14	37	**37**		4
	5.0														
5							5.0	15	13	13	16	42	**42**		5
6		2.0		SM	Grayish medium to very dense silty sands	6.0	6.0	7	9	9	12	30	**30**		6
	7.0														
7							7.0	3	4	4	6	14	**14**		7
8				ML	Gray blackish soft to stiff low plastic clayey silts with fine sands		8.0	4	3	4	5	12	**12**		8
9							9.0	2	2	3	4	9	**9**		9
10							10.0	3	2	2	3	7	**7**		10

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tundikhel, Kathmandu, Nepal **Position :** 629882.5 E, 3065788 N

Bore Hole No.: BH - 04 **Reduced Level (m)** : 1298.592

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
10															10
11							SPT 11.0	2	1	2	1	4	4		11
12							12.0	2	2	1	2	5	5		12
13	***UD 12.5***						13.0	4	3	3	3	9	9		13
14		12.0		ML	Gray blackish soft to stiff low plastic clayey silts with fine sands		14.0	3	2	3	3	8	8		14
15							15.0	4	3	3	3	9	9		15
16							16.0	3	3	4	3	10	10		16
17							17.0	2	1	2	2	5	5		17
18							18.0	2	2	2	1	5	5		18
19	19.0						19.0	3	4	3	3	10	10		19
20							20.0	3	3	2	3	8	8		20

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tundikhel, Kathmandu, Nepal **Position :** 629882.5 E, 3065788 N

Bore Hole No.: BH - 04 **Reduced Level (m)** : 1298.592

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
20															20
21							SPT 21.0	2	1	1	2	4	4		21
	UD 21.5														
22							22.0	2	1	2	1	4	4		22
23							23.0	2	2	1	2	5	5		23
24							24.0	2	2	2	2	6	6		24
25		11.0		MH	Gray blackish soft to medium high plastic clayey silts with fine sands		25.0	4	3	3	3	9	9		25
26							26.0	3	2	3	4	9	9		26
27							27.0	5	4	3	4	11	11		27
28							28.0	4	4	3	3	10	10		28
29							29.0	5	3	4	4	11	11		29
	UD 29.5														
30	30.0						30.0	4	3	4	4	11	11		30

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tundikhel, Kathmandu, Nepal **Position :** 629882.5 E, 3065788 N

Bore Hole No.: BH - 04 **Reduced Level (m)** : 1298.592

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
30							SPT								30
31							31.0	5	4	4	5	13	13		31
32		4.0		ML	Gray blackish stiff low plastic clayey silts with fine sands		32.0	4	5	5	4	14	14		32
33							33.0	4	3	4	5	12	12		33
34	34.0						34.0	4	3	4	4	11	11		34
35							35.0	5	5	4	5	14	14		35
36							36.0	5	5	4	4	13	13		36
37				MH	Blackish stiff high plastic clayey silts with little amount of fine sands		37.0	7	4	4	5	13	13		37
38							38.0	6	5	4	4	13	13		38
39							39.0	5	6	6	5	17	17		39
40							40.0	6	6	5	5	16	16		40

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tundikhel, Kathmandu, Nepal **Position :** 629882.5 E, 3065788 N

Bore Hole No.: BH - 04 **Reduced Level (m)** : 1298.592

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
40															40
	UD 40.5						SPT								
41							41.0	5	5	5	7	17	17		41
42							42.0	6	5	5	6	16	16		42
43							43.0	4	3	3	4	10	10		43
44							44.0	3	2	2	2	6	6		44
45		16.0		MH	Blackish stiff high plastic clayey silts with little amount of fine sands		45.0	3	2	3	3	8	8		45
	UD 45.5														
46							46.0	4	5	4	6	15	15		46
47							47.0	5	4	3	4	11	11		47
48							48.0	5	5	3	4	12	12		48
49							49.0	5	5	6	5	16	16		49
50	50.5						50.0	4	6	5	5	16	16		50

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tripureshwor, Kathmandu, Nepal **Position :** 629816.5 E, 3064669 N

Bore Hole No.: BH - 05 **Reduced Level (m)** : 1290.748

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**
0							SPT 1.0	5	2	2	3	7	**7**
1		2.0		SM - GM	Brownish loose non plastic silty sands with gravels, brick bats etc.								
2	2.0						2.0	2	2	2	2	6	**6**
3		1.5		SM - GM	Reddish loose silty poorly graded sands with gravels, pebbles		3.0	3	2	3	3	8	**8**
4	3.5												
		1.5		ML	Gray blackish medium to stiff low plastic clayey silts with sands		4.0	2	1	2	2	5	**5**
5	5.0						5.0	3	3	6	6	15	**15**
6	6.0	1.0		ML - SM	Gray blackish medium dense slight plastic silty sands (Sandy loam)	5.5	6.0	8	7	7	9	23	**23**
7		2.5		SW	Whitish meduium to very dense well graded sands with little fines		7.0	10	8	12	13	33	**33**
8	8.5						8.0	12	15	18	21	54	**≥50***
9				ML	Gray blackish medium to stiff low plastic clayey silts with sands		9.0	4	2	2	2	6	**6**
10							10.0	4	4	3	2	9	**9**

SPT: 0 10 20 30 40 50

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tripureshwor, Kathmandu, Nepal **Position :** 629816.5 E, 3064669 N

Bore Hole No.: BH - 05 **Reduced Level (m)** : 1290.748

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	**Total SPT Value**	SPT 0 10 20 30 40 50	Scale
10															10
11		4.5		ML	Gray blackish medium to stiff low plastic clayey silts with sands		SPT 11.0	4	2	2	2	6	6		11
12							12.0	4	2	3	2	7	7		12
13	13.0						13.0	2	1	1	1	3	3		13
14	***UD 13.5*** 14.5	1.5		ML	Gray blackish soft to medium low plastic sandy silts		14.0	1	1	2	2	5	5		14
15							15.0	2	2	2	3	7	7		15
16							16.0	2	3	3	3	9	9		16
17				ML	Gray blackish medium to stiff low plastic clayey silts with little amount of fine sands		17.0	2	3	3	4	10	10		17
18							18.0	3	2	2	3	7	7		18
19	***UD 19.5***						19.0	3	2	3	3	8	8		19
20							20.0	3	2	3	3	8	8		20

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tripureshwor, Kathmandu, Nepal **Position :** 629816.5 E, 3064669 N

Bore Hole No.: BH - 05 **Reduced Level (m)** : 1290.748

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	Total SPT Value	SPT 0 10 20 30 40 50	Scale
20															20
21							SPT 21.0	2	3	3	3	9	9		21
22		10.5		ML	Gray blackish medium to stiff low plastic clayey silts with little amount of fine sands		22.0	5	4	4	4	12	12		22
23							23.0	5	5	5	4	14	14		23
24	***UD 23.5***						24.0	3	4	4	4	12	12		24
25	25.0						25.0	3	4	4	3	11	11		25
26							26.0	3	2	3	4	9	9		26
27				ML	Gray blackish stiff low plastic clayey silts with little amount of fine sands		27.0	3	3	3	3	9	9		27
28	***UD 28.5***						28.0	3	3	5	4	12	12		28
29							29.0	3	3	4	4	11	11		29
30							30.0	3	3	2	3	8	8		30

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tripureshwor, Kathmandu, Nepal **Position :** 629816.5 E, 3064669 N

Bore Hole No.: BH - 05 **Reduced Level (m)** : 1290.748

Scale	Depth m	Thickness m	Symbol	Classification	SOIL DESCRIPTION	Water Table m	SPT/DCP at m	No. of Blows per 15/10 cm Penetration 15/10	25/20	35/30	45/40	Total SPT/DCPT Value	Total SPT Value	SPT 0 10 20 30 40 50	Scale
30															30
31							SPT 31.0	3	3	3	3	9	9		31
32							32.0	3	2	2	2	6	6		32
33							33.0	4	2	2	3	7	7		33
	UD 33.5														
34		14.0		ML	Gray blackish stiff low plastic clayey silts with little amount of fine sands		34.0	3	2	3	3	8	8		34
35							35.0	2	2	4	4	10	10		35
36							36.0	3	3	3	4	10	10		36
37							37.0	3	3	3	3	9	9		37
38							38.0	3	3	4	5	12	12		38
	39.0														
39							39.0	3	4	5	6	15	15		39
	UD 39.5														
40							40.0	3	4	4	5	13	13		40

*** Maximum SPT Value.**

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BORE HOLE LOG

Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan **Depth (m) :** 50.0m

Location: Tripureshwor, Kathmandu, Nepal **Position :** 629816.5 E, 3064669 N

Bore Hole No.: BH - 05 **Reduced Level (m)** : 1290.748

Scale	Depth	Thickness	Symbol	Classification	SOIL DESCRIPTION	Water Table	SPT/DCP at	No. of Blows per 15/10 cm Penetration				Total SPT/DCPT Value	**Total SPT Value**	SPT	Scale
	m	m				m	m	15/10	25/20	35/30	45/40			0 10 20 30 40 50	
40															40
41							SPT 41.0	3	4	4	5	13	13		41
42							42.0	3	4	3	5	12	12		42
43							43.0	5	4	4	5	13	13		43
44							44.0	3	5	6	6	17	17		44
45		11.5		ML	Gray blackish stiff to very stiff low plastic clayey silts with fine sands		45.0	3	4	5	6	15	15		45
46							46.0	5	5	7	7	19	19		46
47							47.0	3	4	4	5	13	13		47
48							48.0	3	4	4	4	12	12		48
49							49.0	4	3	4	5	12	12		49
	UD 49.5														
50	50.5						50.0	4	4	5	5	14	14		50

*** Maximum SPT Value.**

Pashupati Drilling & Geo- Technical Services Pvt. Ltd.

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ANNEX - C
DESIGN PARAMETERS

Design Parameters for Different Depths of Manahara, Kathmandu, Nepal

Bore Hole No.	BH - 01									
Depth, Df (m)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Saturated Density γ_{sat} (KN/m^3)	16	17	18	19	19	20	20	20	20	20
Angle of friction (ϕ), Degree	26	29	32	39	39	42	42	42	45	45
Cohesion (C.), KN/m^2	0	0	0	0	0	0	0	0	0	0

Bore Hole No.	BH - 01									
Depth, Df (m)	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Saturated Density γ_{sat} (KN/m^3)	20	20	20	20	19	19	19	20	20	20
Angle of friction (ϕ), Degree	44	47	47	49	38	41	20	20	45	48
Cohesion (C.), KN/m^2	0	0	0	0	0	0	9	9	0	0

Bore Hole No.	BH - 01									
Depth, Df (m)	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
Saturated Density γ_{sat} (KN/m^3)	20	19	20	20	20	20	20	20	20	20
Angle of friction (ϕ), Degree	43	41	42	49	48	43	43	43	46	43
Cohesion (C.), KN/m^2	0	0	0	0	0	0	0	0	0	0

Bore Hole No.	BH - 01									
Depth, Df (m)	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
Saturated Density γ_{sat} (KN/m^3)	20	20	20	20	20	19	20	20	20	19
Angle of friction (ϕ), Degree	47	43	44	45	24	24	24	24	24	18
Cohesion (C.), KN/m^2	0	0	0	0	8	8	8	8	8	12

Bore Hole No.	BH - 01									
Depth, Df (m)	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
Saturated Density γ_{sat} (KN/m^3)	18	19	19	19	19	20	19	20	20	20
Angle of friction (ϕ), Degree	18	18	18	18	18	21	21	21	21	21
Cohesion (C.), KN/m^2	12	12	12	12	12	10	10	10	10	10

Design Parameters for Different Depths of Tinkune Park, Kathmandu, Nepal

Bore Hole No.	BH - 02									
Depth, Df (m)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Saturated Density γ_{sat} (KN/m^3)	20	20	16	19	19	18	18	18	19	19
Angle of friction (ϕ), Degree	38	38	29	35	37	33	34	34	38	38
Cohesion (C.), KN/m^2	0	0	0	0	0	0	0	0	0	0

Bore Hole No.	BH - 02									
Depth, Df (m)	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Saturated Density γ_{sat} (KN/m^3)	19	19	19	19	19	18	18	18	18	18
Angle of friction (ϕ), Degree	41	39	37	40	41	24	24	24	24	24
Cohesion (C.), KN/m^2	0	0	0	0	0	6	6	6	6	6

Bore Hole No.	BH - 02									
Depth, Df (m)	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
Saturated Density γ_{sat} (KN/m^3)	18	18	19	17	17	18	18	17	18	17
Angle of friction (ϕ), Degree	24	24	24	24	20	20	20	17	17	17
Cohesion (C.), KN/m^2	6	6	6	6	10	10	10	9	9	9

Bore Hole No.	BH - 02									
Depth, Df (m)	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
Saturated Density γ_{sat} (KN/m^3)	17	17	17	18	18	18	18	18	18	18
Angle of friction (ϕ), Degree	17	17	17	17	17	17	17	17	17	17
Cohesion (C.), KN/m^2	9	9	9	9	9	9	9	9	9	13

Bore Hole No.	BH - 02									
Depth, Df (m)	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
Saturated Density γ_{sat} (KN/m^3)	19	18	19	18	18	18	18	19	18	18
Angle of friction (ϕ), Degree	17	17	17	17	17	17	17	17	17	
Cohesion (C.), KN/m^2	13	13	13	13	13	13	13	13	13	13

Design Parameters for Different Depths of New Baneshwor, Kathmandu, Nepal

Bore Hole No.	BH - 03									
Depth, Df (m)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Saturated Density γ_{sat} (KN/m^3)	17	19	18	19	19	17	16	20	20	20
Angle of friction (ϕ), Degree	18	35	33	38	38	20	20	48	48	49
Cohesion (C.), KN/m^2	5	0	0	0	0	7	7	0	0	0

Bore Hole No.	BH - 03									
Depth, Df (m)	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Saturated Density γ_{sat} (KN/m^3)	20	17	19	19	19	19	20	20	17	17
Angle of friction (ϕ), Degree	43	19	19	38	41	40	41	42	19	19
Cohesion (C.), KN/m^2	0	8	8	0	0	0	0	0	7	7

Bore Hole No.	BH - 03									
Depth, Df (m)	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
Saturated Density γ_{sat} (KN/m^3)	16	16	17	16	17	18	17	17	17	17
Angle of friction (ϕ), Degree	19	19	19	19	18	18	18	18	18	18
Cohesion (C.), KN/m^2	7	7	7	7	11	11	11	11	11	11

Bore Hole No.	BH - 03									
Depth, Df (m)	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
Saturated Density γ_{sat} (KN/m^3)	17	16	16	16	16	16	18	17	17	17
Angle of friction (ϕ), Degree	18	17	17	17	17	17	19	19	19	19
Cohesion (C.), KN/m^2	11	10	10	10	10	10	9	9	9	9

Bore Hole No.	BH - 03									
Depth, Df (m)	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
Saturated Density γ_{sat} (KN/m^3)	17	17	18	17	16	16	17	17	18	18
Angle of friction (ϕ), Degree	19	19	19	19	19	19	19	19	19	19
Cohesion (C.), KN/m^2	9	9	9	9	9	9	9	9	9	9

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

Design Parameters for Different Depths of Tundikhel, Kathmandu, Nepal

Bore Hole No.	BH - 04									
Depth, Df (m)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Saturated Density γ_{sat} (KN/m^3)	17	17	19	20	20	20	17	17	16	16
Angle of friction (ϕ), Degree	30	31	36	42	44	40	19	19	19	19
Cohesion (C.), KN/m^2	0	0	0	0	0	0	7	7	7	7

Bore Hole No.	BH - 04									
Depth, Df (m)	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Saturated Density γ_{sat} (KN/m^3)	16	16	16	16	16	17	16	16	17	16
Angle of friction (ϕ), Degree	19	19	19	19	19	19	19	19	17	17
Cohesion (C.), KN/m^2	7	7	7	7	7	7	7	7	6	6

Bore Hole No.	BH - 04									
Depth, Df (m)	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
Saturated Density γ_{sat} (KN/m^3)	16	16	16	16	16	16	17	17	17	17
Angle of friction (ϕ), Degree	17	17	17	17	17	17	17	17	17	22
Cohesion (C.), KN/m^2	6	6	6	6	6	6	6	6	6	8

Bore Hole No.	BH - 04									
Depth, Df (m)	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
Saturated Density γ_{sat} (KN/m^3)	17	17	17	17	17	17	17	17	18	18
Angle of friction (ϕ), Degree	22	22	22	15	15	15	15	15	15	15
Cohesion (C.), KN/m^2	8	8	8	11	11	11	11	11	11	11

Bore Hole No.	BH - 04									
Depth, Df (m)	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
Saturated Density γ_{sat} (KN/m^3)	18	18	17	16	16	18	17	17	18	18
Angle of friction (ϕ), Degree	15	15	18	18	18	18	18	18	18	18
Cohesion (C.), KN/m^2	11	11	9	9	9	9	9	9	9	9

Drilling and Geo-Technical Services Pvt. Ltd. Pashupati

Design Parameters for Different Depths of Tripureshwor, Kathmandu, Nepal

Bore Hole No.	BH - 05									
Depth, Df (m)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Saturated Density γ_{sat} (KN/m^3)	16	16	16	16	18	19	20	20	16	16
Angle of friction (ϕ), Degree	27	26	28	20	33	37	42	48	21	21
Cohesion (C.), KN/m^2	0	0	0	4	0	0	0	0	5	5

Bore Hole No.	BH - 05									
Depth, Df (m)	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Saturated Density γ_{sat} (KN/m^3)	16	16	16	16	16	16	17	16	16	16
Angle of friction (ϕ), Degree	21	21	20	20	19	19	19	19	19	19
Cohesion (C.), KN/m^2	5	5	4	4	7	7	7	7	7	7

Bore Hole No.	BH - 05									
Depth, Df (m)	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0
Saturated Density γ_{sat} (KN/m^3)	16	17	17	17	17	16	16	17	17	16
Angle of friction (ϕ), Degree	19	21	21	21	21	21	21	21	21	21
Cohesion (C.), KN/m^2	7	5	5	5	6	6	6	6	6	6

Bore Hole No.	BH - 05									
Depth, Df (m)	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0
Saturated Density γ_{sat} (KN/m^3)	16	16	16	16	17	17	16	17	18	17
Angle of friction (ϕ), Degree	21	21	21	21	21	21	21	21	22	22
Cohesion (C.), KN/m^2	6	6	6	6	6	6	6	6	9	9

Bore Hole No.	BH - 05									
Depth, Df (m)	41.0	42.0	43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0
Saturated Density γ_{sat} (KN/m^3)	17	17	17	18	18	18	17	17	17	17
Angle of friction (ϕ), Degree	22	22	22	22	22	22	22	22	22	22
Cohesion (C.), KN/m^2	9	9	9	9	9	9	9	9	9	9

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

ANNEX - D

LABORATORY TEST RESULT SUMMARY SHEETS

Pashupati Drilling & Geo- Technical Services Pvt. Ltd.

Krishna Kunj, Ramnagar, Lokanthali-15, Bhaktapur

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LABORATORY TEST RESULT SUMMARY SHEET

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley **Date:** April 2019

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Manahara, Kathmandu, Nepal

Bore Hole No.	Depth & Soil Type	USCS Classi-fication	Percentage of					Atterberg Limits			Natural Moisture content	Moist Density	Dry Density	Specific Gravity	Direct Shear Test (*analytical)		Uncon-fined Compres-sion Test	Consolidation	
			Gravel	Sand		Silt & Clay	Clay	Liquid Limit	Plastic Limit	Plasticity Index					C	ϕ			
				Coarse to medium	Fine														
	(m)		%	%	%	%	%	%	%	%	%	gm/cc	gm/cc		KN/m^2	Degree	KN/m^2	C_c	e_O
BH - 01	1.0 SPT	SM	4.92	45.49	38.52	11.07	6.71				12.50	1.60	1.42	2.472					
	6.0 SPT	SM	0.00	35.16	31.99	32.85	19.92				23.75	1.52	1.05	2.516					
	9.0 SPT	SM	0.00	9.51	61.14	29.35	17.79				20.75	1.43	1.19	2.591					
	13.0 SPT	SP	0.70	41.46	52.96	4.88					22.22	1.42	1.16	2.634					
	15.0 SPT	SM	0.60	40.00	41.79	17.61	10.68				36.36	1.52	0.82	2.569					
	18.0 SPT	ML	3.19	4.78	28.65	63.39	38.43	48.00	42.12	5.88	40.38	1.43	1.02	2.412	9	20	105.69	0.201	0.604
	21.0 SPT	SW - SM	1.28	57.37	33.33	8.01					22.95	1.50	1.22	2.620					
	28.0 SPT	SM	0.00	20.79	43.73	35.48		-	-	-	25.83	1.45	1.00	2.571					
	33.0 SPT	SM	0.00	17.92	55.00	27.08					34.63	1.62	1.12	2.604					
	36.0 SPT	ML	0.00	23.94	13.03	63.03		36.00	31.70	4.30	37.50	1.64	1.19	2.425	8	24		0.113	0.761
	42.0 & UD	ML	0.00	2.27	1.36	96.36	28.75	43.50	33.33	10.17	41.94	1.64	1.15	2.437	12	18		0.115	0.817
	49.0 & UD	ML	0.00	11.03	24.14	64.83	19.34	35.50	28.21	7.29	38.30	1.44	1.04	2.491	10	21	128.04	0.161	0.996

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LABORATORY TEST RESULT SUMMARY SHEET

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley **Date:** April 2019

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tinkune Park, Kathmandu, Nepal

Bore Hole No.	Depth & Soil Type	USCS Classi-fication	Percentage of					Atterberg Limits			Natural Moisture content	Moist Density	Dry Density	Specific Gravity	Direct Shear Test (*analytical)		Uncon-fined Compres-sion Test	Consolidation	
			Gravel	Sand		Silt & Clay	Clay	Liquid Limit	Plastic Limit	Plasticity Index					C	ϕ			
				Coarse to medium	Fine														
	(m)		%	%	%	%	%	%	%	%	%	gm/cc	gm/cc		KN/m^2	Degree	KN/m^2	C_c	e_O
BH - 02	2.0 SPT	SM	29.96	30.77	15.79	23.48	10.95				12.20	1.43	1.27	2.625					
	4.0 SPT	SM	0.53	25.59	35.59	38.28	17.86				13.00	1.52	1.35	2.280					
	6.0 SPT	SW	20.75	56.81	16.86	5.58					14.52	1.53	1.34	1.000					
	8.0 SPT	SM	0.00	15.55	69.61	14.85	6.93				26.25	1.34	1.06	2.587					
	10.0 SPT	SW	1.14	49.67	41.50	7.68					17.20	1.54	1.31	2.565					
	13.0 SPT	SM	0.00	5.03	69.27	25.70	11.99				37.68	1.47	1.07	2.570					
	24.0 & UD	ML	0.00	0.00	19.76	80.24	37.43	37.00	29.11	7.89	40.79	1.57	1.11	2.416	6	25	94.64	0.138	0.746
	27.0 SPT	ML	0.00	0.00	1.61	98.39		36.5	28.57	7.93	53.33	1.62	1.06	2.441	10	20		0.125	0.809
	31.5 & UD	ML	0.00	0.00	2.07	97.93	21.69	45.5	32.00	13.50	52.86	1.59	0.83	2.484	9	17	97.08	0.165	1.260
	45.5 & UD	ML	0.00	0.00	3.36	96.64	21.41	40.00	30.43	9.57	69.57	1.63	0.96	2.500	13	17	113.12	0.124	0.935

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LABORATORY TEST RESULT SUMMARY SHEET

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley **Date:** April 2019

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: New Baneshwor, Kathmandu, Nepal

Bore Hole No.	Depth & Soil Type	USCS Classi-fication	Percentage of					Atterberg Limits			Natural Moisture content	Moist Density	Dry Density	Specific Gravity	Direct Shear Test (*analytical)		Uncon-fined Compres-sion Test	Consolidation	
			Gravel	Sand		Silt & Clay	Clay	Liquid Limit	Plastic Limit	Plasticity Index					C	ϕ			
				Coarse to medium	Fine														
	(m)		%	%	%	%	%	%	%	%	%	gm/cc	gm/cc		KN/m^2	Degree	KN/m^2	C_c	e_O
BH - 03	1.0 SPT	ML	0.00	0.92	17.39	81.69	21.40	33.50	29.37	4.13	29.09	1.50	1.37	2.523	5	18		0.210	0.815
	4.0 SPT	SP	4.00	38.22	51.11	6.67					16.28	1.33	1.15	2.624					
	5.0 SPT	SP	0.00	6.78	90.55	2.67					25.00	1.29	1.16	2.588					
	8.0 SPT	SM	0.00	13.00	59.57	27.44	7.19				33.48	1.41	1.21	2.650					
	12.0 SPT	ML	0.00	1.96	8.31	89.73	23.51	38.50	32.04	6.46	45.65	1.53	1.05	2.500	8	19		0.183	0.794
	14.5 SPT	SP	0.00	8.99	86.24	4.76					31.82	1.36	1.26	2.684					
	16.0 SPT	SP	0.00	45.39	46.71	7.89					26.67	1.37	1.08	2.526					
	17.0 SPT	SM	0.00	28.66	43.30	28.04	7.35				29.25	1.52	1.12	2.559					
	22.5 & UD	ML	0.00	0.00	4.04	95.96	25.14	39.00	27.11	11.89	51.16	1.74	1.15	2.470	7	19		0.266	0.926
	27.0 & UD	ML	0.00	0.00	3.61	96.39	27.04	42.00	31.69	10.31	55.52	1.76	1.06	2.483	11	18	88.58	0.139	0.836
	34.0 & UD	ML	0.00	0.00	4.53	95.47		47.50	37.83	9.67	58.42	1.72	1.02	2.475	10	17	52.22	0.165	0.981
	47.5 & UD	ML	0.00	0.00	5.10	94.90	26.62	45.00	31.75	13.25	51.81	1.62	1.11	2.435	9	19	77.69	0.144	0.885

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LABORATORY TEST RESULT SUMMARY SHEET

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley **Date:** April 2019

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tundikhel, Kathmandu, Nepal

Bore Hole No.	Depth & Soil Type	USCS Classi-fication	Percentage of					Atterberg Limits			Natural Moisture content	Moist Density	Dry Density	Specific Gravity	Direct Shear Test (*analytical)		Uncon-fined Compres-sion Test	Consolidation	
			Gravel	Sand		Silt & Clay	Clay	Liquid Limit	Plastic Limit	Plasticity Index					C	ϕ			
				Coarse to medium	Fine														
	(m)		%	%	%	%	%	%	%	%	%	gm/cc	gm/cc		KN/m^2	Degree	KN/m^2	C_c	e_O
BH - 04	2.0 SPT	SM	0.87	38.70	36.09	24.35	6.36				18.18	1.41	1.19	2.557					
	4.0 SPT	SM	17.27	49.58	10.86	22.28	5.82				15.13	1.56	1.35	2.617					
	5.0 SPT	SM	1.16	48.65	37.45	12.74	3.33				13.16	1.27	1.12	2.608					
	7.0 SPT	SM	9.89	29.67	12.09	48.35	12.62	-	-	-	43.90	1.66	1.16	2.632					
	10.0 SPT	ML	0.00	8.27	1.97	89.76		40.50	31.68	8.82	59.65	1.31	0.82	2.596					
	12.5 & UD	ML	0.00	0.00	2.04	97.96	25.58	47.00	37.33	9.67	50.77	1.40	0.93	2.409	7	19	43.69	0.191	0.751
	20.0 SPT	MH	0.00	0.00	1.28	98.72	25.78	52.00	40.61	11.39	62.96	1.27	0.78	2.418					
	21.5 & UD	MH	0.00	0.00	1.27	98.73		54.0	42.22	11.78	50.00	1.33	0.89	2.148	6	17	38.44	0.266	0.948
	32.0 SPT	ML	0.00	0.00	3.49	96.51		44.5	36.20	8.30	74.74	1.38	0.71	2.227	8	22		0.138	0.814
	40.5 & UD	MH	0.00	0.00	1.55	98.45	41.54	56.00	45.28	10.72	85.24	1.35	0.69	2.233	11	15	96.08	0.282	0.875
	45.5 & UD	MH	0.00	0.00	3.41	96.59		55.50	42.73	12.77	79.39	1.36	0.70	2.344	9	18	103.34	0.259	0.986

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LABORATORY TEST RESULT SUMMARY SHEET

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley **Date:** April 2019

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tripureshwor, Kathmandu, Nepal

Bore Hole No.	Depth & Soil Type	USCS Classi-fication	Percentage of					Atterberg Limits			Natural Moisture content	Moist Density	Dry Density	Specific Gravity	Direct Shear Test (*analytical)		Uncon-fined Compres-sion Test	Consolidation	
			Gravel	Sand		Silt & Clay	Clay	Liquid Limit	Plastic Limit	Plasticity Index					C	ϕ			
				Coarse to medium	Fine														
	(m)		%	%	%	%	%	%	%	%	%	gm/cc	gm/cc		KN/m^2	Degree	KN/m^2	C_c	e_O
BH - 05	1.0 SPT	SM - GM	32.04	23.79	11.17	33.01	8.16				31.43	1.34	1.02	2.630					
	3.0 SPT	SM - GM	42.11	28.95	7.89	21.05	5.21				25.00	1.45	1.16	2.596					
	5.0 SPT	ML - SM	0.40	21.47	32.60	45.53	11.26				32.61	1.59	1.20	2.600					
	7.0 SPT	SW	0.00	56.38	37.86	5.76					24.32	1.42	1.14	2.677					
	13.5 & UD	ML	0.00	12.84	2.11	85.05	21.03	36.50	26.00	10.50	43.24	1.64	1.14	2.320	4	20		0.182	0.715
	16.0 & UD	ML	0.00	0.00	7.14	92.86		43.00	32.61	10.39	78.00	1.67	0.84	2.300	7	19	42.42	0.158	0.843
	23.5 & UD	ML	0.00	0.00	4.07	95.93	26.38	49.00	36.15	12.85	61.52	1.71	0.82	2.310	5	21	98.07	0.133	0.886
	33.5 & UD	ML	0.00	0.00	6.04	93.96		49.00	35.50	13.50	66.67	1.72	0.84	2.413	6	21	52.86	0.181	0.993
	48.0 & UD	ML	0.00	0.00	8.00	92.00	25.30	47.50	31.33	16.17	59.52	1.74	0.83	2.337	9	22	866.33	0.156	0.849

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Manahara, Kathmandu, Nepal

Bore Hole No.: BH - 01

Depth (m)	D50	D10	F_c	P_c
1.0 SPT	0.43	0.075	11.07	6.709
6.0 SPT	0.32	0.075	32.85	19.919
9.0 SPT	0.19	0.075	29.35	17.794
13.0 SPT	0.39	0.17	4.88	
15.0 SPT	0.38	0.075	17.61	10.678
18.0 SPT			63.39	38.431
21.0 SPT	0.58	0.12	8.01	
28.0 SPT			35.48	
33.0 SPT			27.08	
36.0 SPT			63.03	
42.0 & UD			96.36	28.745
49.0 & UD			64.83	19.338

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tinkune Park, Kathmandu, Nepal

Bore Hole No.: BH - 02

Depth (m)	D50	D10	F_c	P_c
2.0 SPT	1.10	0.075	23.48	10.954
4.0 SPT	0.10	0.075	38.28	17.860
6.0 SPT	1.30	0.2	5.58	
8.0 SPT	0.21	0.075	14.85	6.927
10.0 SPT	0.42	0.14	7.68	
13.0 SPT	0.19	0.075	25.70	11.988
24.0 & UD			80.24	37.432
27.0 SPT			98.39	
31.5 & UD			97.93	21.692
45.5 & UD			96.64	21.406

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: New Baneshwor, Kathmandu, Nepal

Bore Hole No.: BH - 03

Depth (m)	D50	D10	F_c	P_c
1.0 SPT			81.69	21.404
4.0 SPT	0.39	0.17	6.67	
5.0 SPT	0.24	0.18	2.67	
8.0 SPT	0.20	0.075	27.44	7.188
12.0 SPT			89.73	23.510
14.5 SPT	0.22	0.15	4.76	
16.0 SPT	0.37	0.13	7.89	
17.0 SPT	0.21	0.075	28.04	7.346
22.5 & UD			95.96	25.140
27.0 & UD			96.39	27.036
34.0 & UD			95.47	
47.5 & UD			94.90	26.621

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tundikhel, Kathmandu, Nepal

Bore Hole No.: BH - 04

Depth (m)	D50	D10	F_c	P_c
2.0 SPT	0.32	0.075	24.35	6.357
4.0 SPT	1.80	0.075	22.28	5.818
5.0 SPT	0.42	0.075	12.74	3.327
7.0 SPT	0.09	0.075	48.35	12.625
10.0 SPT			89.76	
12.5 & UD			97.96	25.577
20.0 SPT			98.72	25.777
21.5 & UD			98.73	
32.0 SPT			96.51	
40.5 & UD			98.45	41.544
45.5 & UD			96.59	

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tripureshwor, Kathmandu, Nepal

Bore Hole No.: BH - 05

Depth (m)	D50	D10	F_c	P_c
1.0 SPT	0.80	0.075	33.01	8.163
3.0 SPT	3.00	0.075	21.05	5.206
5.0 SPT	0.48	0.18	45.53	11.260
7.0 SPT			5.76	
13.5 & UD			85.05	21.034
16.0 & UD			92.86	
23.5 & UD			95.93	26.382
33.5 & UD			93.96	
48.0 & UD			92.00	25.300

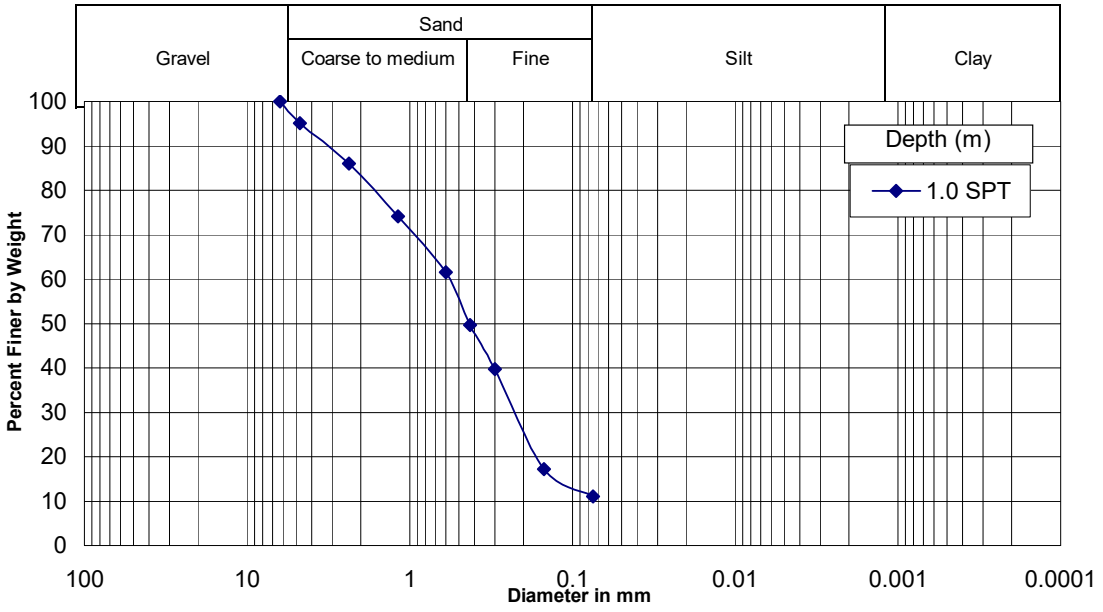
GRAIN SIZE DISTRIBUTION

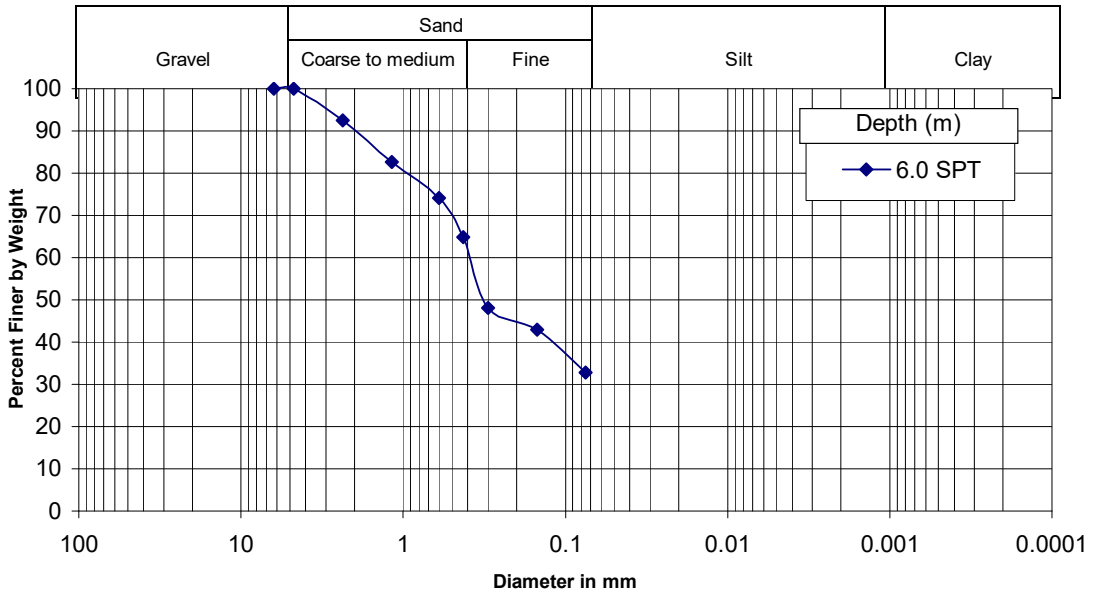
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Manahara, Kathmandu, Nepal **Bore Hole No.:** BH - 01





Remarks:

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Tel : 00977-1-5182310, 9851026210 E-mail: pashupatidrilling@gmail.com

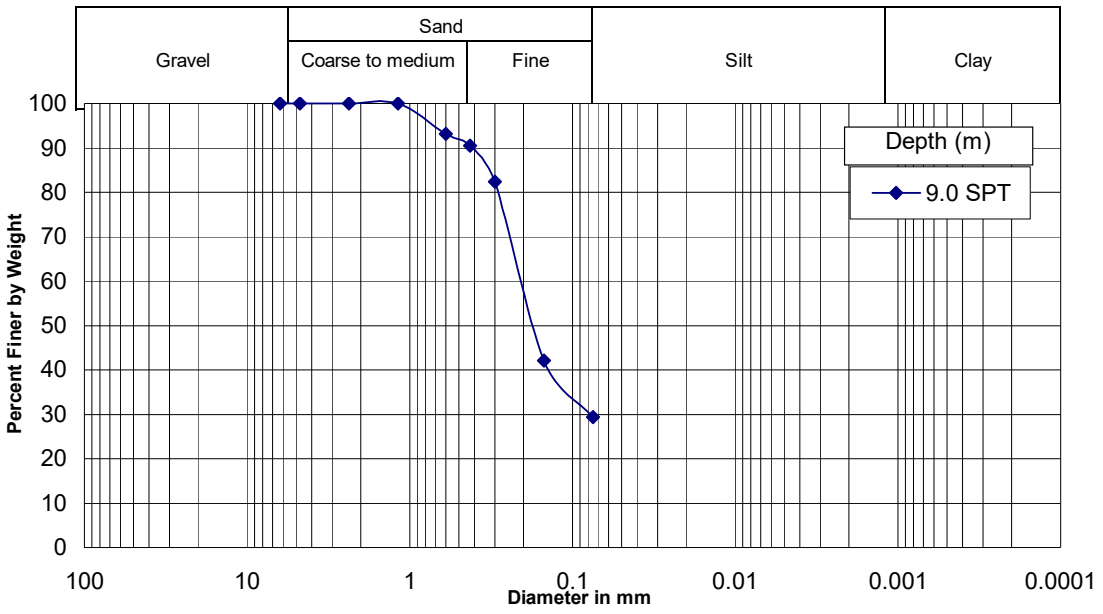
GRAIN SIZE DISTRIBUTION

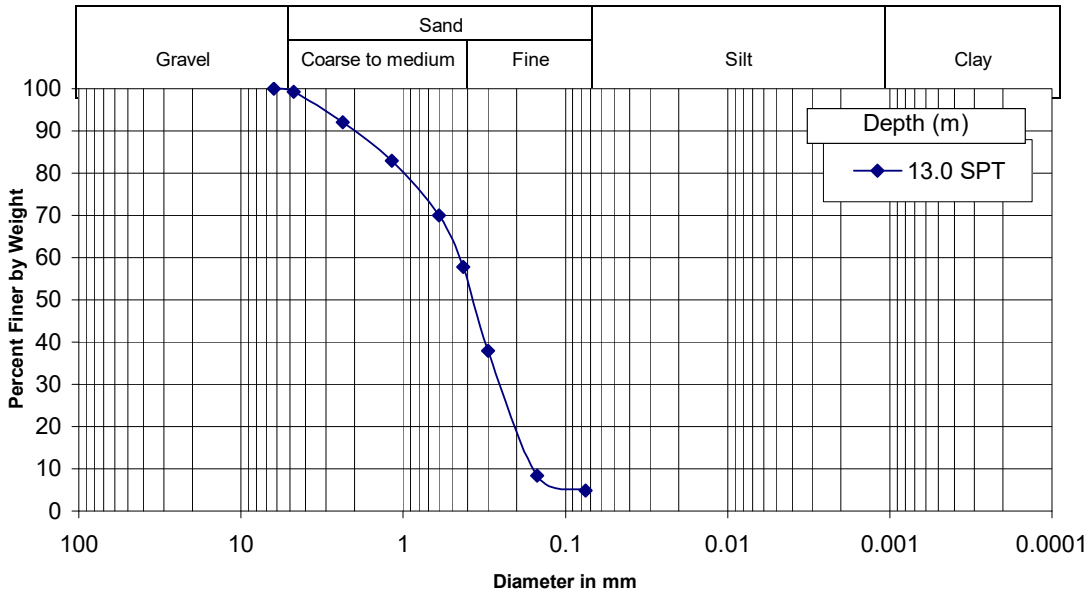
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Manahara, Kathmandu, Nepal **Bore Hole No.:** BH - 01





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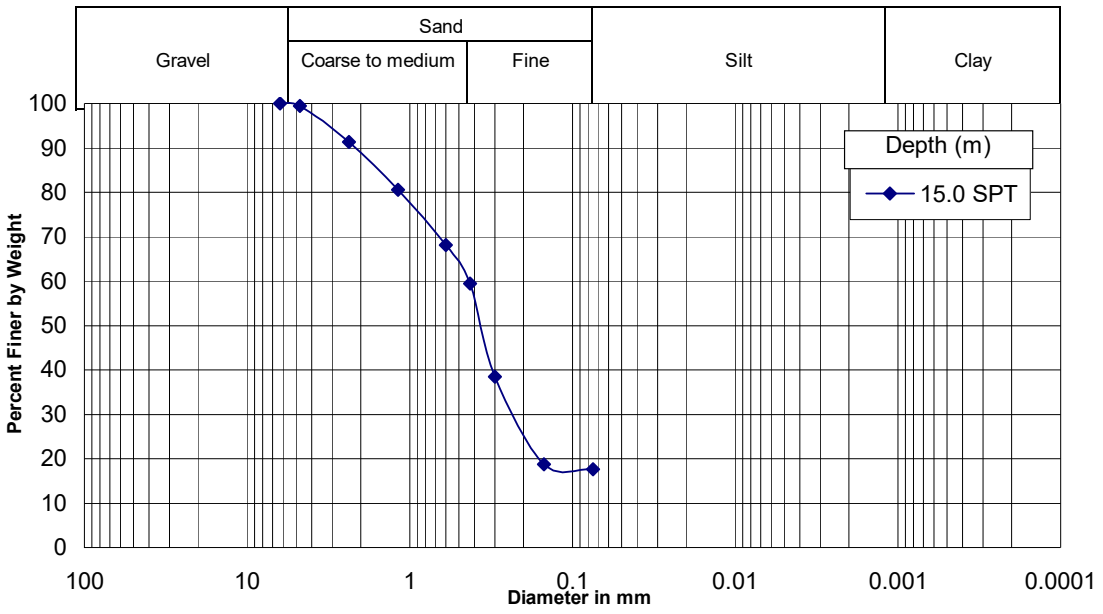

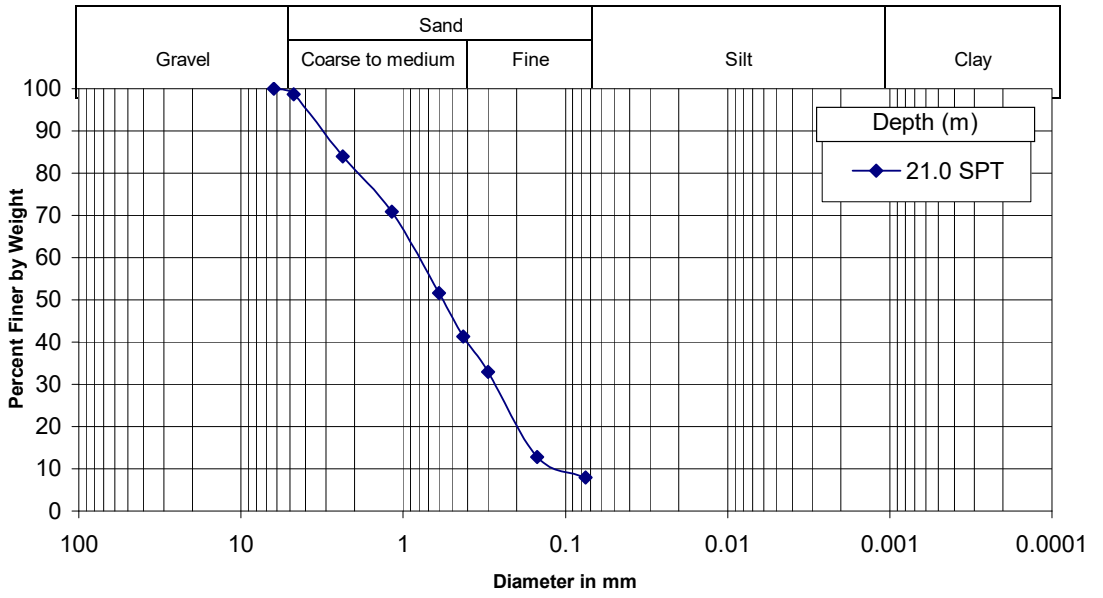

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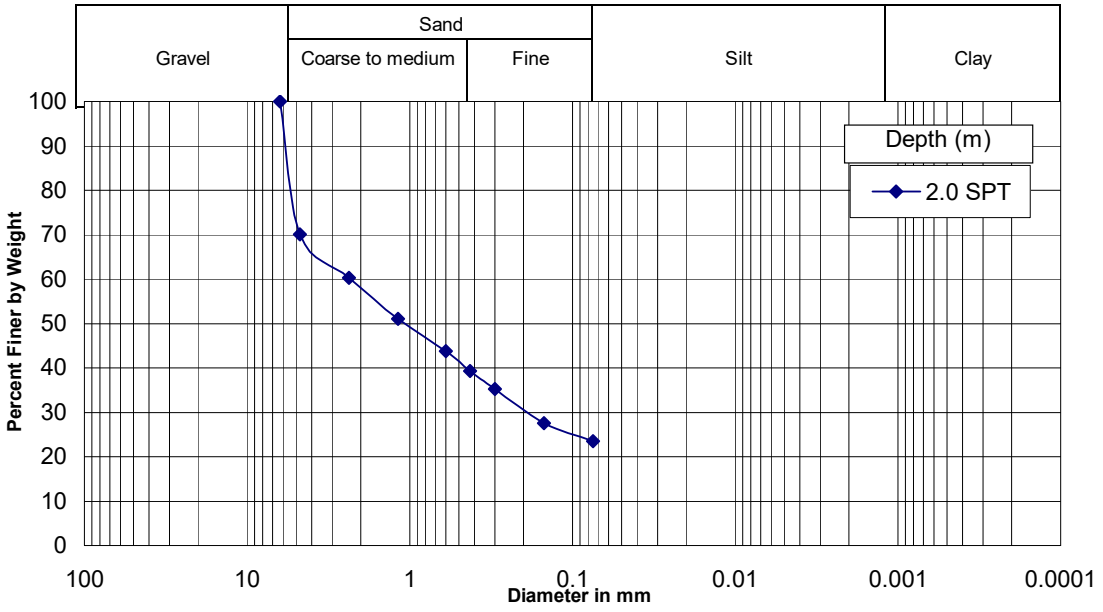
GRAIN SIZE DISTRIBUTION

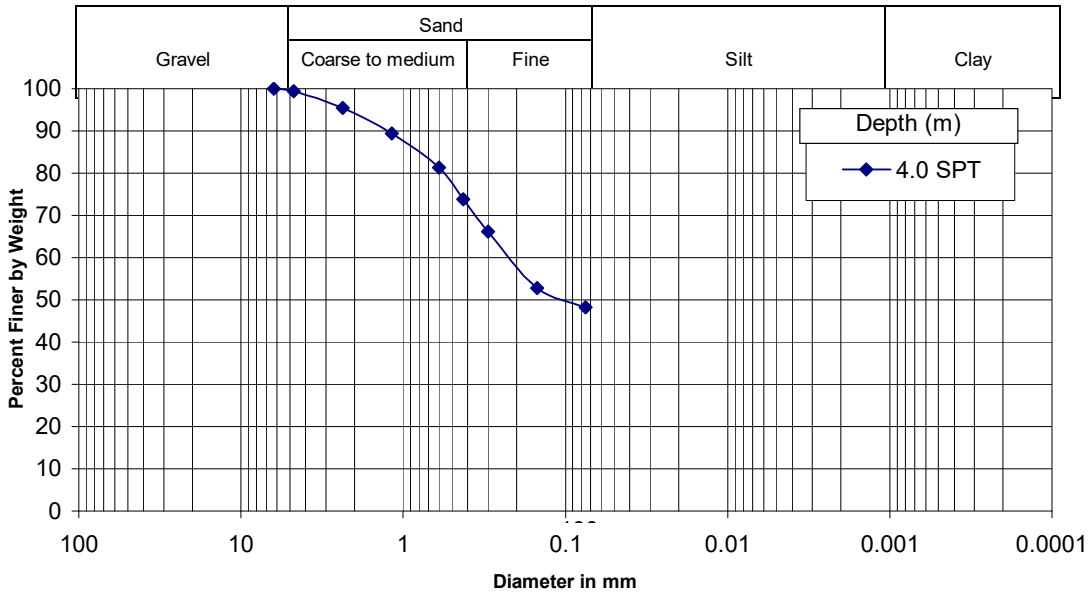
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tinkune Park, Kathmandu, Nepal **Bore Hole No.:** BH - 02





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GRAIN SIZE DISTRIBUTION

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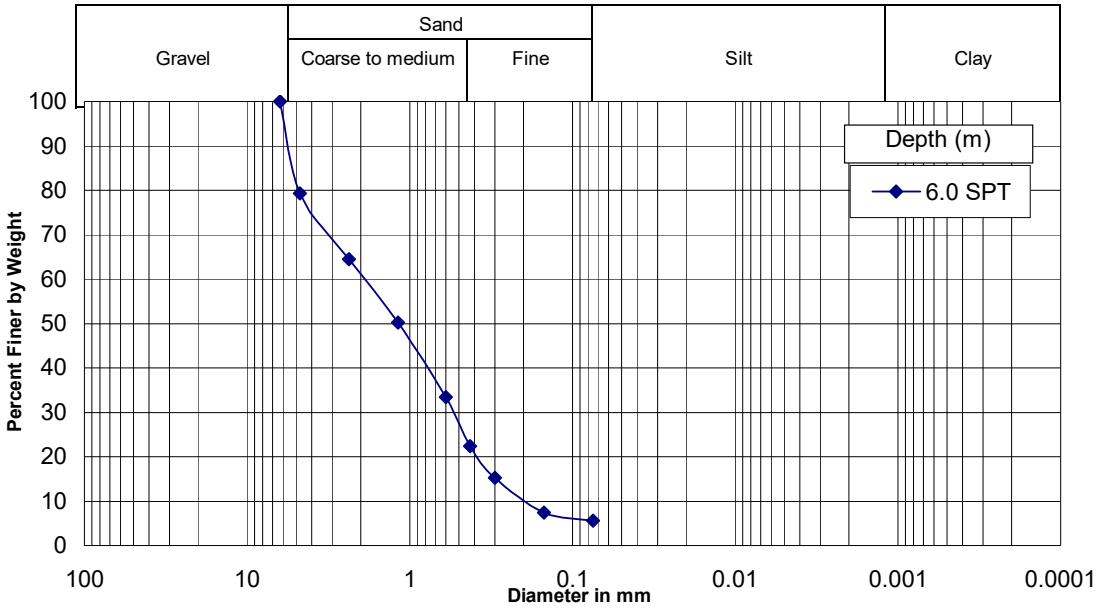
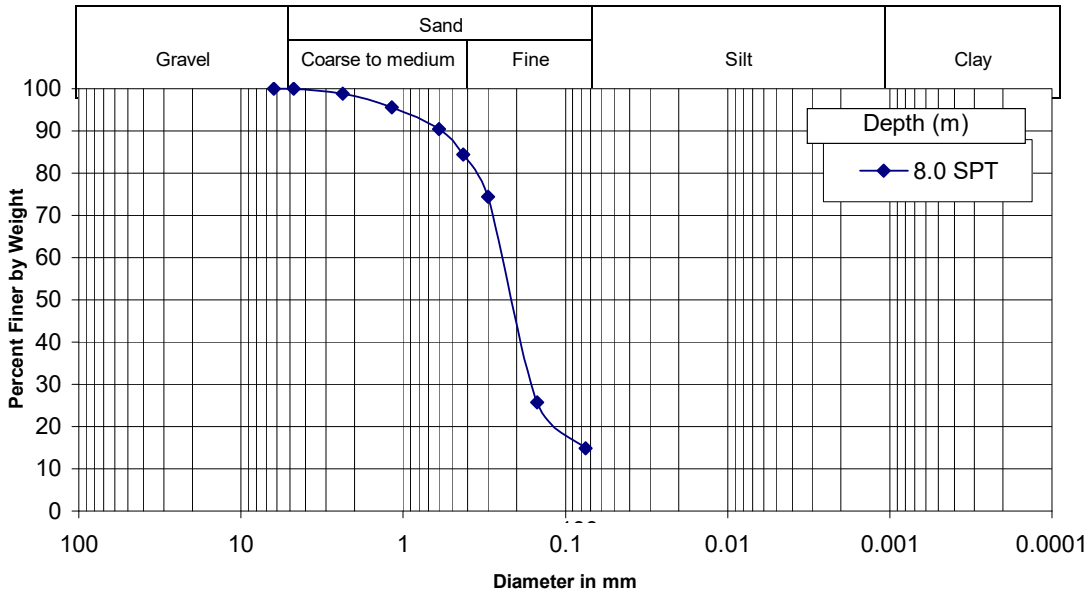
Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tinkune Park, Kathmandu, Nepal **Bore Hole No.:** BH - 02





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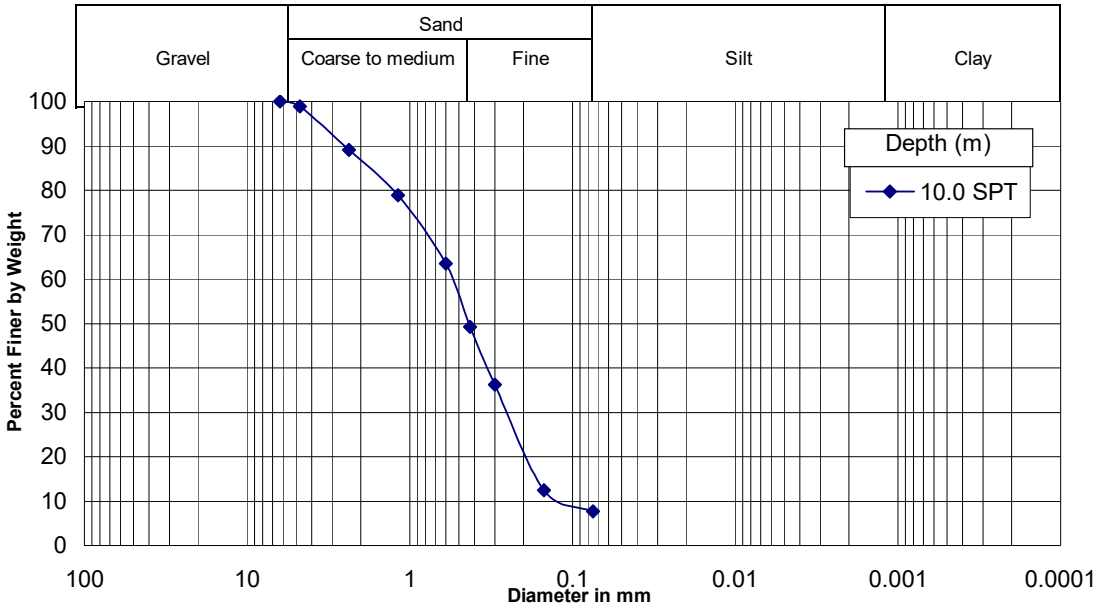

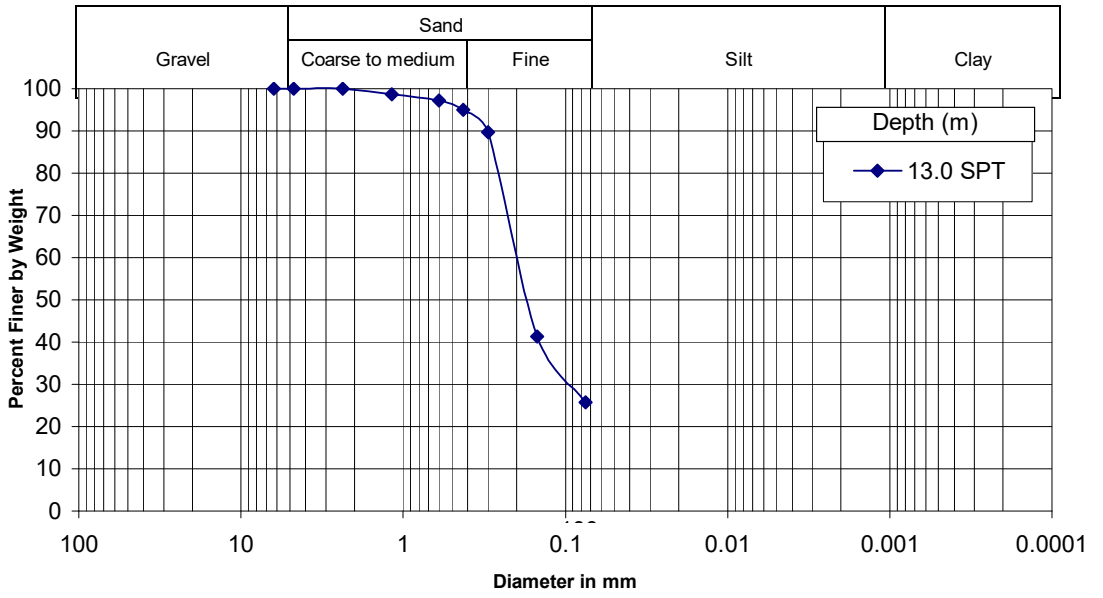

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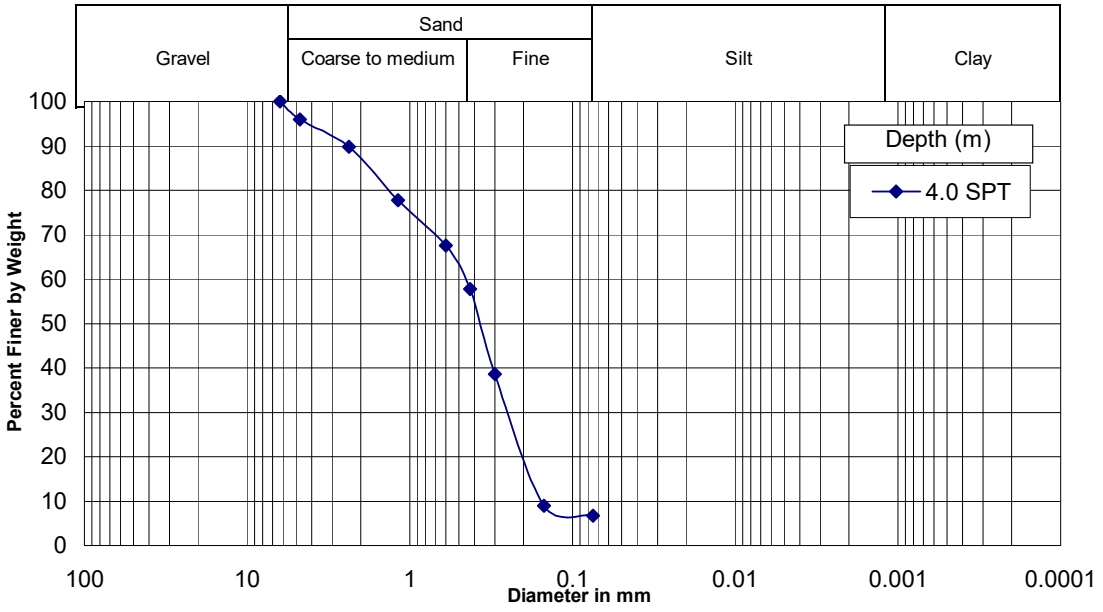
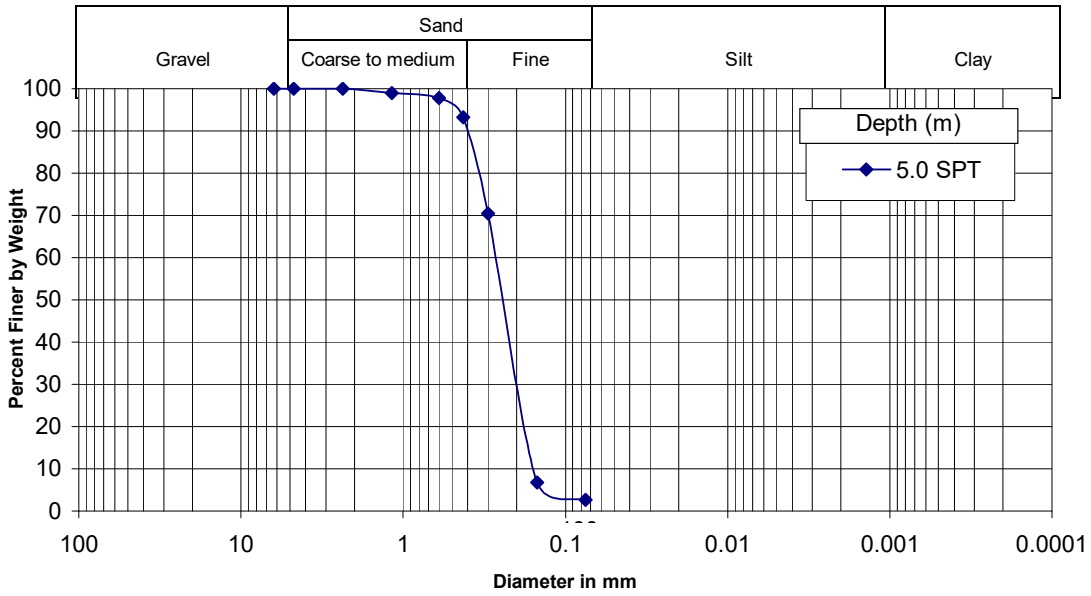
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: New Baneshwor, Kathmandu, Nepal **Bore Hole No.:** BH - 03





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Pashupati Drilling and Geo- Technical Services Pvt. Ltd.

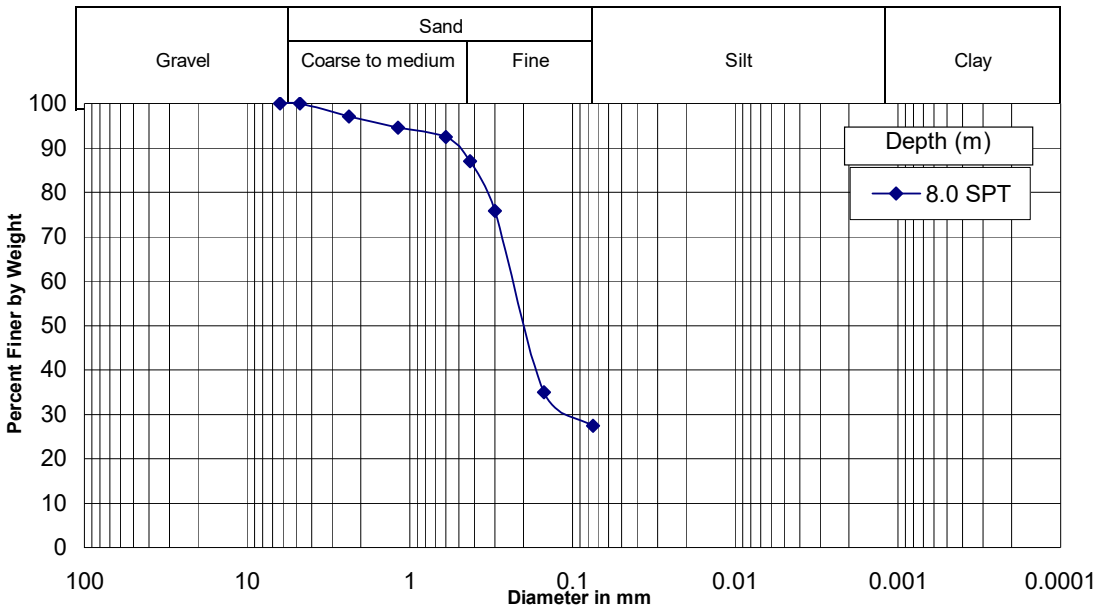
GRAIN SIZE DISTRIBUTION

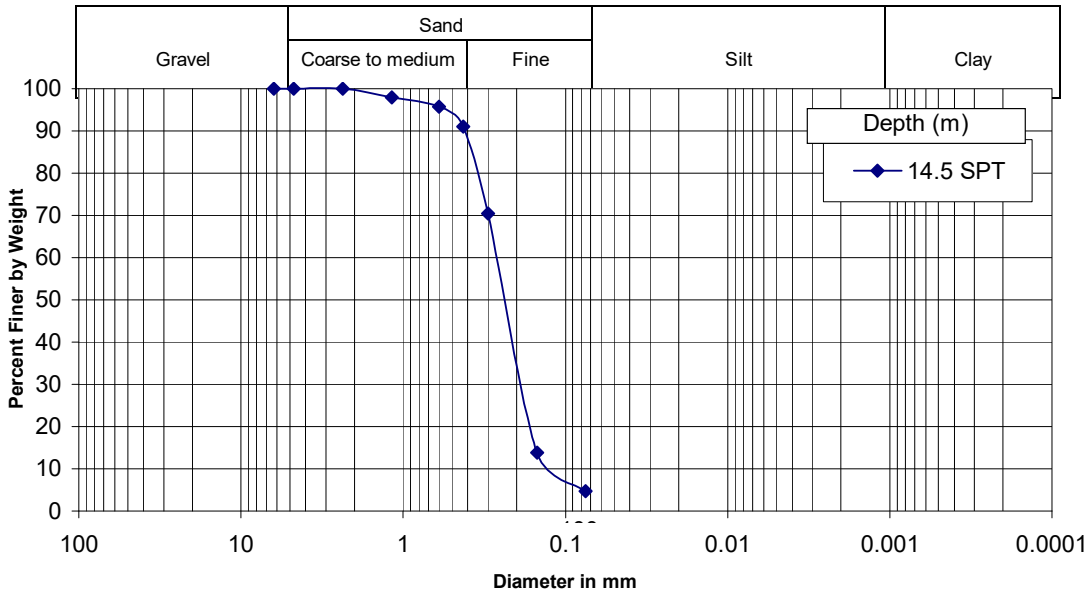
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: New Baneshwor, Kathmandu, Nepal **Bore Hole No.:** BH - 03





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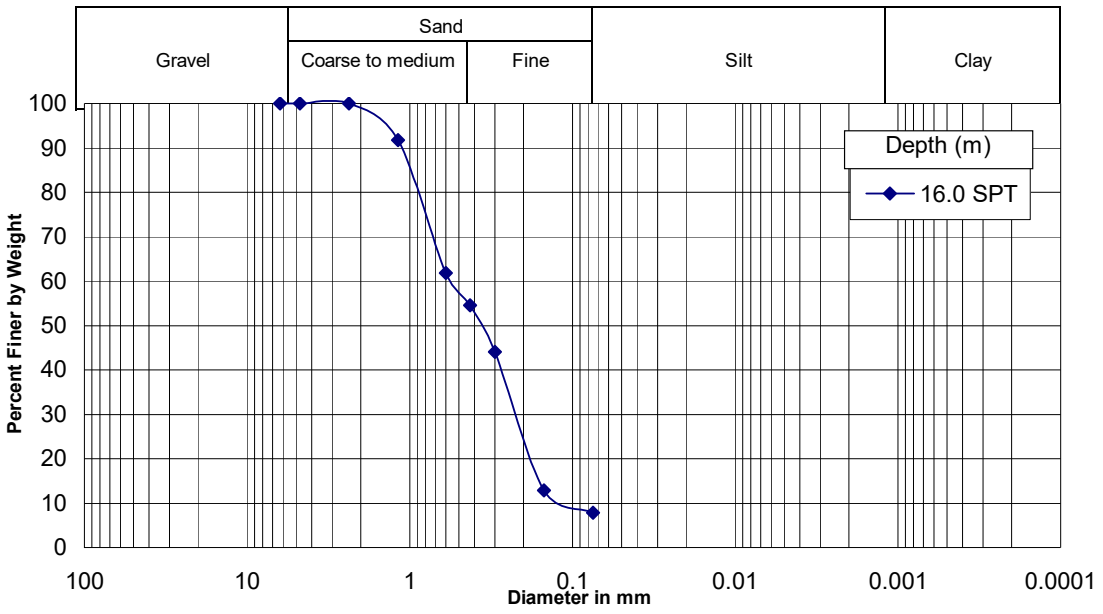

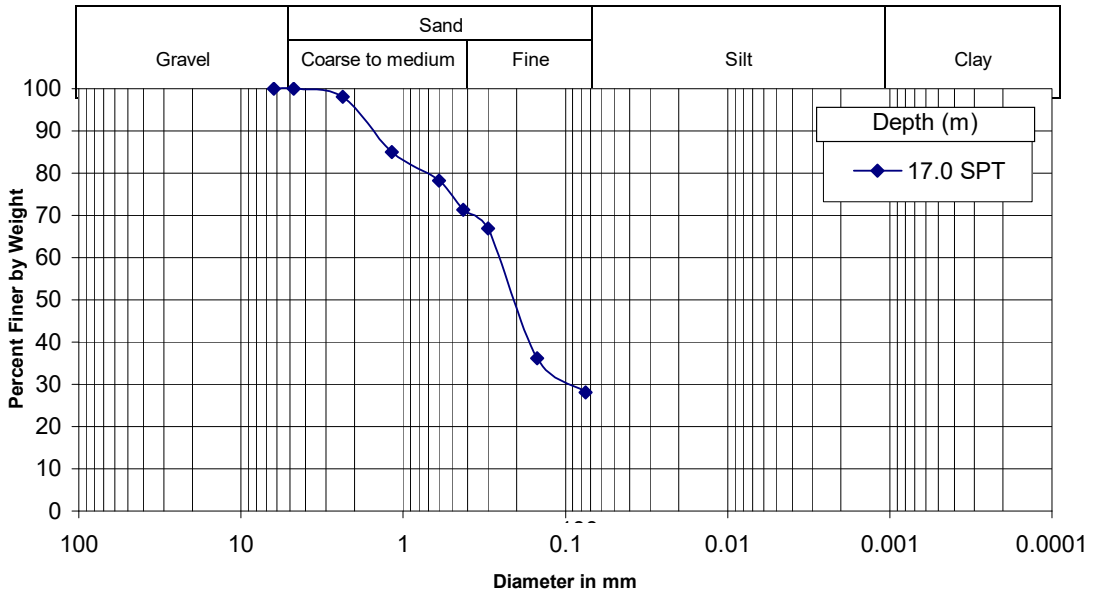

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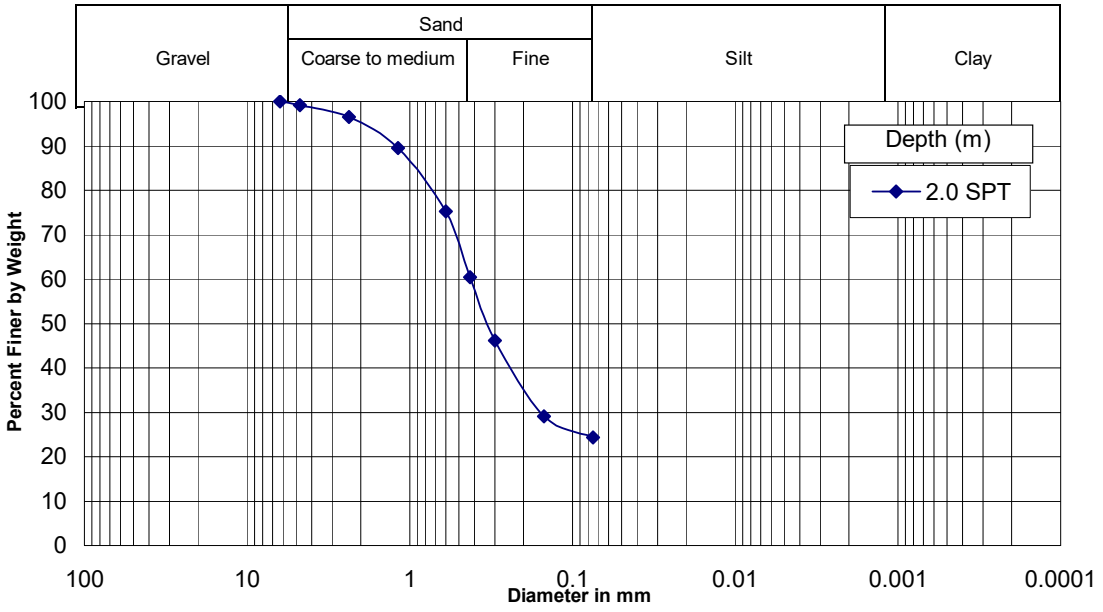
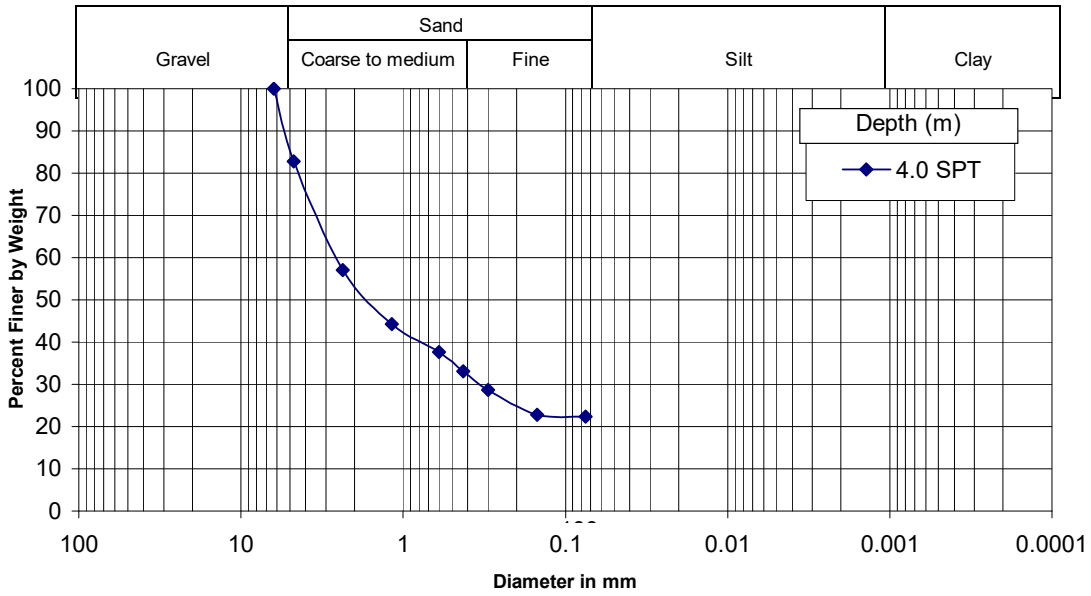
Location: Tundikhel, Kathmandu, Nepal **Bore Hole No.:** BH - 04





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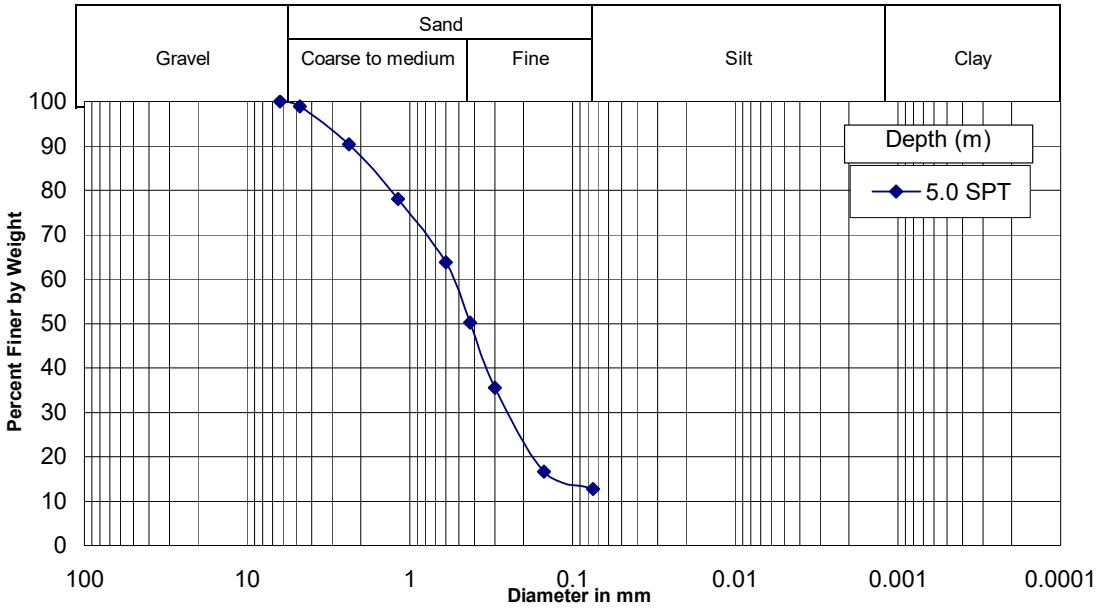

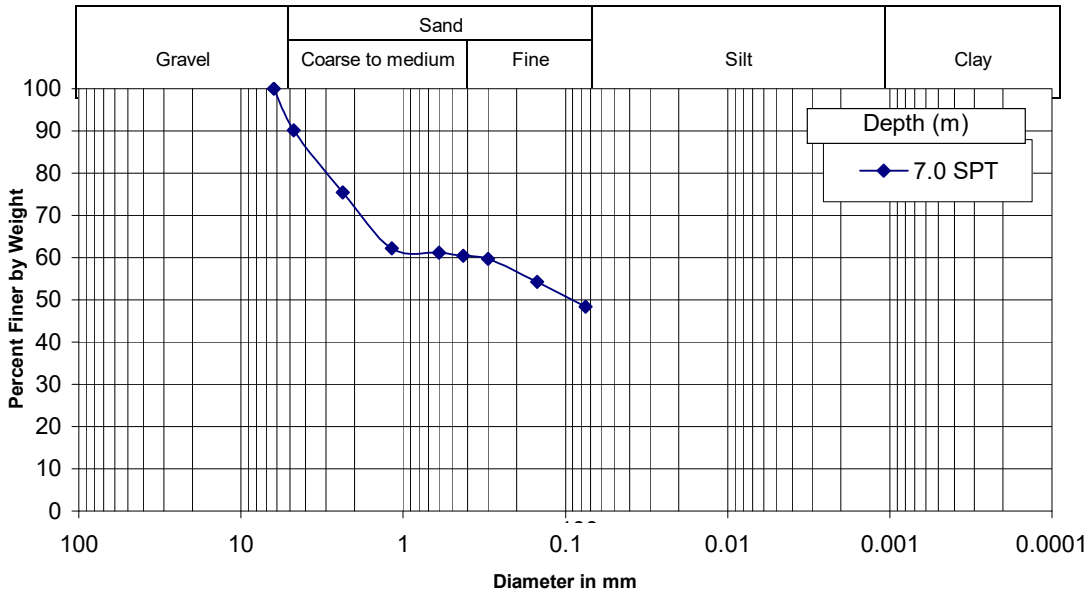

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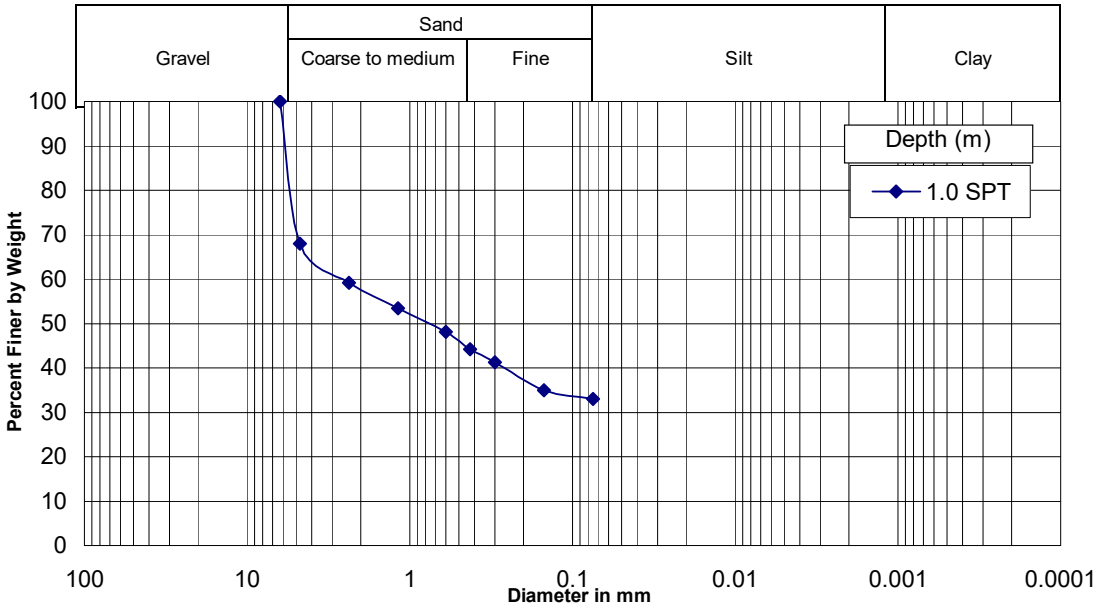
GRAIN SIZE DISTRIBUTION

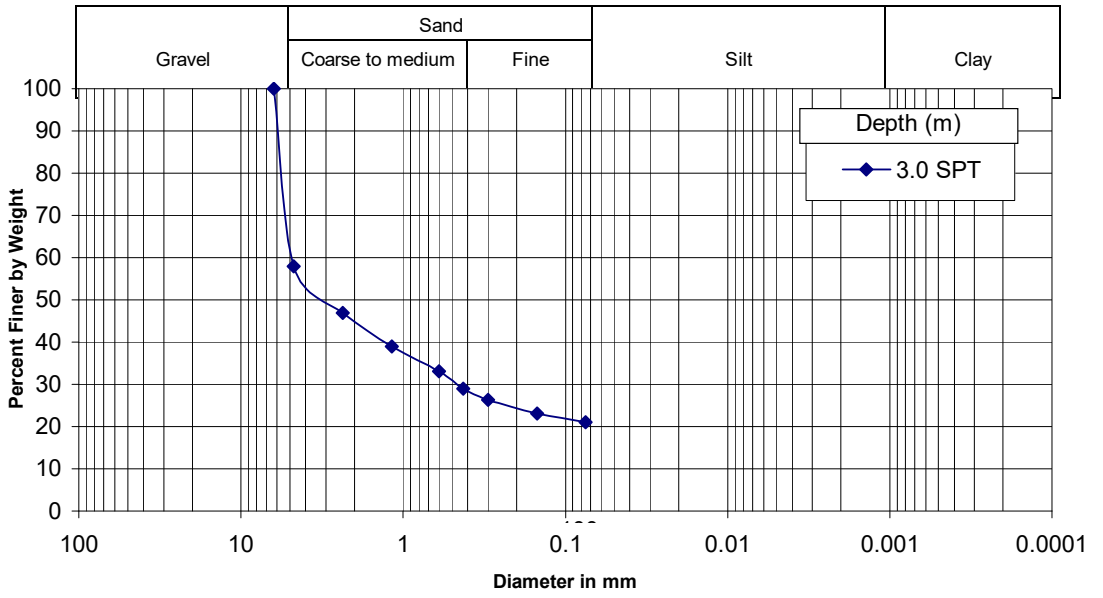
Date : April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tripureshwor, Kathmandu, Nepal **Bore Hole No.:** BH - 05





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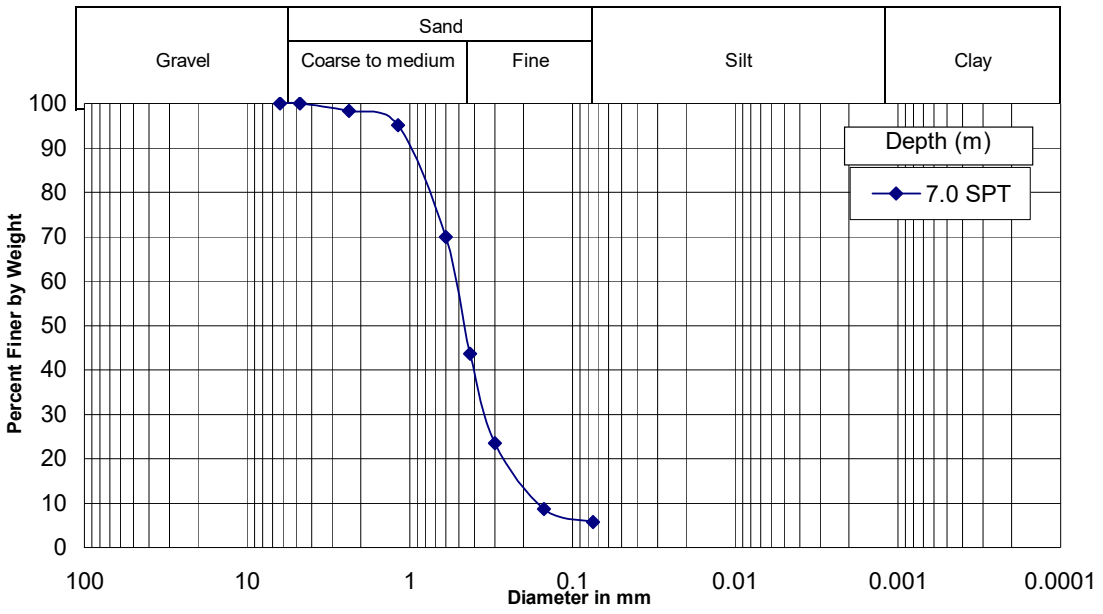
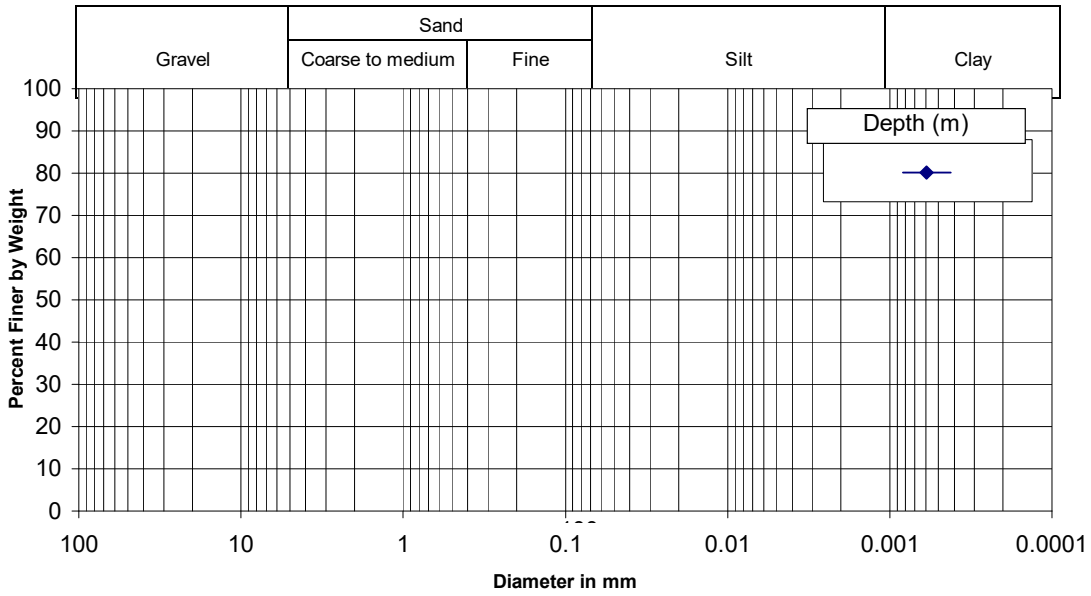
Location: Tripureshwor, Kathmandu, Nepal **Bore Hole No.:** BH - 05





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Tel : 00977-1-5182310, 9851026210 E-mail: pashupatidrilling@gmail.com

GRADATION TEST

Location : Manahara, Kathmandu, Nepal
Bore Hole No.: BH - 01 **Depth of Sample :** 18.0 SPT
Total wt. = **125.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	4.0	4.00	96.81
2.36	3.0	7.00	94.42
2	0.0	7.00	94.42
1.18	1.0	8.00	93.63
0.85	0.0	8.00	93.63
0.6	1.0	9.00	92.83
0.425	1.0	10.00	92.03
0.3	2.5	12.50	90.04
0.15	20.0	32.50	74.10
0.075	26.0	58.50	53.39

ASTM classification

>4.75	mm	**gravel**	3.19
4.75--0.425	mm	**Coarse to mediur**	4.78
0.425--0.075	mm	**Fine**	38.65
0.075--0.005	mm	**Silt**	21.02
<0.005	mm	**Clay**	32.37

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.407
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.412
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0220	22.00	3.50	18.50	3.407	63.02	22.50	9.750	9.75	0.0152	0.0474	63.02
	2	25	1.0215	21.50	3.50	18.00	3.407	61.32	22.00	9.840	4.92	0.0152	0.0336	61.32
	3	25	1.0195	19.50	3.50	16.00	3.407	54.51	20.00	9.238	3.08	0.0152	0.0266	54.51
	5	25	1.0190	19.00	3.50	15.50	3.407	52.80	19.50	9.328	1.87	0.0152	0.0207	52.80
	10	25	1.0180	18.00	3.50	14.50	3.406	49.39	18.50	9.508	0.95	0.0151	0.0147	49.39
	15	25	1.0170	17.00	3.50	13.50	3.406	45.99	17.50	9.688	0.65	0.0151	0.0121	45.99
	30	25	1.0160	16.00	3.50	12.50	3.407	42.58	16.50	9.868	0.33	0.0152	0.0087	42.58
	60	25	1.0150	15.00	3.50	11.50	3.407	39.18	15.50	10.048	0.17	0.0152	0.0062	39.18
	120	25	1.0130	13.00	3.50	9.50	3.407	32.37	13.50	10.408	0.09	0.0153	0.0045	32.37
	240	25	1.0105	10.50	3.50	7.00	3.407	23.85	11.00	10.858	0.0452	0.0153	0.0032	23.85
	480	25	1.0090	9.00	3.50	5.50	3.406	18.74	9.50	11.128	0.0232	0.0151	0.0023	18.74
	1440	25	1.0060	6.00	3.50	2.50	3.407	8.52	6.50	11.668	0.0081	0.0153	0.0014	8.52

Geo-Technical Services Pvt. Ltd. Pashupati Dhungana

GRADATION TEST

Location : Manahara, Kathmandu, Nepal
Bore Hole No.: BH - 01 **Depth of Sample :** 42.0 UD
Total wt. = **220** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	2.0	2.00	99.09
2	0.0	2.00	99.09
1.18	1.0	3.00	98.64
0.85	0.0	3.00	98.64
0.6	1.0	4.00	98.18
0.425	1.0	5.00	97.73
0.3	1.0	6.00	97.27
0.15	1.0	7.00	96.82
0.075	1.0	8.00	96.36

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	2.27
0.425--0.075	mm	**Fine**	1.36
0.075--0.005	mm	**Silt**	67.61
<0.005	mm	**Clay**	28.75

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.382
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.437
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0240	24.00	3.50	20.50	3.382	69.33	24.50	9.390	9.39	0.0152	0.0465	69.33
	2	25	1.0225	22.50	3.50	19.00	3.382	64.26	23.00	9.660	4.83	0.0152	0.0333	64.26
	3	25	1.0210	21.00	3.50	17.50	3.382	59.19	21.50	8.968	2.99	0.0152	0.0262	59.19
	5	25	1.0190	19.00	3.50	15.50	3.382	52.42	19.50	9.328	1.87	0.0152	0.0207	52.42
	10	25	1.0175	17.50	3.50	14.00	3.382	47.35	18.00	9.598	0.96	0.0151	0.0148	47.35
	15	25	1.0160	16.00	3.50	12.50	3.382	42.27	16.50	9.868	0.66	0.0151	0.0122	42.27
	30	25	1.0145	14.50	3.50	11.00	3.382	37.20	15.00	10.138	0.34	0.0152	0.0088	37.20
	60	25	1.0130	13.00	3.50	9.50	3.382	32.13	13.50	10.408	0.17	0.0152	0.0063	32.13
	120	25	1.0120	12.00	3.50	8.50	3.383	28.75	12.50	10.588	0.09	0.0153	0.0045	28.75
	240	25	1.0110	11.00	3.50	7.50	3.383	25.37	11.50	10.768	0.0449	0.0153	0.0032	25.37
	480	25	1.0090	9.00	3.50	5.50	3.382	18.60	9.50	11.128	0.0232	0.0151	0.0023	18.60
	1440	25	1.0075	7.50	3.50	4.00	3.383	13.53	8.00	11.398	0.0079	0.0153	0.0014	13.53

Geo-Technical Services Pvt. Ltd. Pashupati Dham

GRADATION TEST

Location : Tinkune Park, Kathmandu, Nepal

Bore Hole No.: BH - 02 **Depth of Sample :** 24.0 UD

Total wt. = **83.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	2.0	2.00	97.60
0.15	7.5	9.50	88.62
0.075	7.0	16.50	80.24

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	19.76
0.075--0.005	mm	**Silt**	42.80
<0.005	mm	**Clay**	37.44

K1 = [Gs xYc/(Gs-1)]x[100/Ws]

K_{24} = (2.2*0.99712/(2.2-1))*(100/50)

= 3.403

K_2 = SQRT(30xn/(980*(Ys - Yw))

$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))

0.01517

Hydrometer Analysis:-

Hydrometer type :

Dispersing agent $NaPO_3$

Zero correction :

SG of solids : 2.416

Amount : 4 % in 125 ml

Meniscus correction : 0.5

rw = 0.998

Wt. Of soil, Ws = 50.00 gms.

Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0240	24.00	3.00	21.00	3.403	71.45	24.50	9.390	9.39	0.0152	0.0465	71.45
	2	25	1.0230	23.00	3.00	20.00	3.403	68.05	23.50	9.570	4.79	0.0152	0.0332	68.05
	3	25	1.0225	22.50	3.00	19.50	3.403	66.35	23.00	8.698	2.90	0.0152	0.0258	66.35
	5	25	1.0220	22.00	3.00	19.00	3.403	64.65	22.50	8.788	1.76	0.0152	0.0201	64.65
	10	25	1.0200	20.00	3.00	17.00	3.402	57.84	20.50	9.148	0.91	0.0151	0.0144	57.84
	15	25	1.0185	18.50	3.00	15.50	3.402	52.74	19.00	9.418	0.63	0.0151	0.0120	52.74
	30	25	1.0170	17.00	3.00	14.00	3.403	47.64	17.50	9.688	0.32	0.0152	0.0086	47.64
	60	25	1.0155	15.50	3.00	12.50	3.403	42.53	16.00	9.958	0.17	0.0152	0.0062	42.53
	120	25	1.0140	14.00	3.00	11.00	3.403	37.44	14.50	10.228	0.09	0.0153	0.0045	37.44
	240	25	1.0110	11.00	3.00	8.00	3.403	27.23	11.50	10.768	0.0449	0.0153	0.0032	27.23
	480	25	1.0090	9.00	3.00	6.00	3.402	20.41	9.50	11.128	0.0232	0.0151	0.0023	20.41
	1440	25	1.0070	7.00	3.00	4.00	3.403	13.61	7.50	11.488	0.0080	0.0153	0.0014	13.61

Geo-Technical Services Pvt. Ltd. Pashupati Drilling

GRADATION TEST

Location : Tinkune Park, Kathmandu, Nepal

Bore Hole No.: BH - 02 **Depth of Sample :** 31.5 UD

Total wt. = **121** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	0.0	0.00	100.00
0.15	1.5	1.50	98.76
0.075	1.0	2.50	97.93

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	2.07
0.075--0.005	mm	**Silt**	76.23
<0.005	mm	**Clay**	21.70

K1 = [Gs xYc/(Gs-1)]x[100/Ws]

K_{24} = (2.2*0.99712/(2.2-1))*(100/50)

= 3.338

K_2 = SQRT(30xn/(980*(Ys - Yw))

$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))

0.01517

Hydrometer Analysis:-

Hydrometer type :

Dispersing agent $NaPO_3$

Zero correction :

SG of solids : 2.484

Amount : 4 % in 125 ml

Meniscus correction : 0.5

rw = 0.998

Wt. Of soil, Ws = 50.00 gms.

Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0180	18.00	3.00	15.00	3.338	50.07	18.50	10.470	10.47	0.0152	0.0491	50.07
	2	25	1.0160	16.00	3.00	13.00	3.338	43.39	16.50	10.830	5.42	0.0152	0.0353	43.39
	3	25	1.0150	15.00	3.00	12.00	3.338	40.06	15.50	10.048	3.35	0.0152	0.0278	40.06
	5	25	1.0145	14.50	3.00	11.50	3.338	38.39	15.00	10.138	2.03	0.0152	0.0216	38.39
	10	25	1.0140	14.00	3.00	11.00	3.338	36.72	14.50	10.228	1.02	0.0151	0.0153	36.72
	15	25	1.0125	12.50	3.00	9.50	3.338	31.71	13.00	10.498	0.70	0.0151	0.0126	31.71
	30	25	1.0110	11.00	3.00	8.00	3.338	26.70	11.50	10.768	0.36	0.0152	0.0091	26.70
	60	25	1.0100	10.00	3.00	7.00	3.338	23.37	10.50	10.948	0.18	0.0152	0.0065	23.37
	120	25	1.0095	9.50	3.00	6.50	3.339	21.70	10.00	11.038	0.09	0.0153	0.0046	21.70
	240	25	1.0075	7.50	3.00	4.50	3.339	15.02	8.00	11.398	0.0475	0.0153	0.0033	15.02
	480	25	1.0060	6.00	3.00	3.00	3.338	10.01	6.50	11.668	0.0243	0.0151	0.0024	10.01
	1440	25	1.0040	4.00	3.00	1.00	3.339	3.34	4.50	12.028	0.0084	0.0153	0.0014	3.34

Geo-Technical Services Pvt. Ltd. Pashupati

GRADATION TEST

Location : New Baneshwor, Kathmandu, Nepal
Bore Hole No.: BH - 03 **Depth of Sample :** 22.5 UD
Total wt. = **136** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	0.0	0.00	100.00
0.15	1.0	1.00	99.26
0.075	4.5	5.50	95.96

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	4.04
0.075--0.005	mm	**Silt**	70.82
<0.005	mm	**Clay**	25.14

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.351
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.470
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0195	19.50	3.00	16.50	3.351	55.29	20.00	10.200	10.20	0.0152	0.0484	55.29
	2	25	1.0185	18.50	3.00	15.50	3.351	51.94	19.00	10.380	5.19	0.0152	0.0346	51.94
	3	25	1.0165	16.50	3.00	13.50	3.351	45.24	17.00	9.778	3.26	0.0152	0.0274	45.24
	5	25	1.0150	15.00	3.00	12.00	3.351	40.21	15.50	10.048	2.01	0.0152	0.0215	40.21
	10	25	1.0135	13.50	3.00	10.50	3.351	35.18	14.00	10.318	1.03	0.0151	0.0153	35.18
	15	25	1.0120	12.00	3.00	9.00	3.351	30.16	12.50	10.588	0.71	0.0151	0.0127	30.16
	30	25	1.0115	11.50	3.00	8.50	3.351	28.48	12.00	10.678	0.36	0.0152	0.0090	28.48
	60	25	1.0110	11.00	3.00	8.00	3.351	26.81	11.50	10.768	0.18	0.0152	0.0064	26.81
	120	25	1.0105	10.50	3.00	7.50	3.352	25.14	11.00	10.858	0.09	0.0153	0.0046	25.14
	240	25	1.0090	9.00	3.00	6.00	3.352	20.11	9.50	11.128	0.0464	0.0153	0.0033	20.11
	480	25	1.0070	7.00	3.00	4.00	3.351	13.40	7.50	11.488	0.0239	0.0151	0.0023	13.40
	1440	25	1.0050	5.00	3.00	2.00	3.352	6.70	5.50	11.848	0.0082	0.0153	0.0014	6.70

Geo-Technical Services Pvt. Ltd. Pashupati Drilling

GRADATION TEST

Location : New Baneshwor, Kathmandu, Nepal
Bore Hole No.: BH - 03 **Depth of Sample :** 34.0 UD
Total wt. = **121.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	1.5	1.50	98.77
0.15	2.0	3.50	97.12
0.075	2.0	5.50	95.47

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	4.53
0.075--0.005	mm	**Silt**	68.70
<0.005	mm	**Clay**	26.78

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.346
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.475
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0245	24.50	3.00	21.50	3.346	71.94	25.00	9.300	9.30	0.0152	0.0463	71.94
	2	25	1.0225	22.50	3.00	19.50	3.346	65.25	23.00	9.660	4.83	0.0152	0.0333	65.25
	3	25	1.0200	20.00	3.00	17.00	3.346	56.89	20.50	9.148	3.05	0.0152	0.0265	56.89
	5	25	1.0185	18.50	3.00	15.50	3.346	51.87	19.00	9.418	1.88	0.0152	0.0208	51.87
	10	25	1.0170	17.00	3.00	14.00	3.346	46.85	17.50	9.688	0.97	0.0151	0.0148	46.85
	15	25	1.0155	15.50	3.00	12.50	3.346	41.83	16.00	9.958	0.66	0.0151	0.0123	41.83
	30	25	1.0140	14.00	3.00	11.00	3.346	36.81	14.50	10.228	0.34	0.0152	0.0089	36.81
	60	25	1.0125	12.50	3.00	9.50	3.346	31.79	13.00	10.498	0.17	0.0152	0.0063	31.79
	120	25	1.0110	11.00	3.00	8.00	3.347	26.78	11.50	10.768	0.09	0.0153	0.0046	26.78
	240	25	1.0100	10.00	3.00	7.00	3.347	23.43	10.50	10.948	0.0456	0.0153	0.0033	23.43
	480	25	1.0080	8.00	3.00	5.00	3.346	16.73	8.50	11.308	0.0236	0.0151	0.0023	16.73
	1440	25	1.0065	6.50	3.00	3.50	3.347	11.71	7.00	11.578	0.0080	0.0153	0.0014	11.71

Geo-Technical Services Pvt. Ltd. Pashupati Dham

GRADATION TEST

Location : Tundikhel, Kathmandu, Nepal

Bore Hole No.: BH - 04 **Depth of Sample :** 12.5 UD

Total wt. = **122.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	0.0	0.00	100.00
0.15	0.0	0.00	100.00
0.075	2.5	2.50	97.96

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	2.04
0.075--0.005	mm	**Silt**	72.38
<0.005	mm	**Clay**	25.58

K1 = [Gs xYc/(Gs-1)]x[100/Ws]

K_{24} = (2.2*0.99712/(2.2-1))*(100/50)

= 3.410

K_2 = SQRT(30xn/(980*(Ys - Yw))

$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))

0.01517

Hydrometer Analysis:-

Hydrometer type :

Dispersing agent $NaPO_3$

Zero correction :

SG of solids : 2.409

Amount : 4 % in 125 ml

Meniscus correction : 0.5

rw = 0.998

Wt. Of soil, Ws = 50.00 gms.

Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0210	21.00	3.50	17.50	3.410	59.67	21.50	9.930	9.93	0.0152	0.0478	59.67
	2	25	1.0200	20.00	3.50	16.50	3.410	56.26	20.50	10.110	5.06	0.0152	0.0341	56.26
	3	25	1.0175	17.50	3.50	14.00	3.410	47.73	18.00	9.598	3.20	0.0152	0.0271	47.73
	5	25	1.0165	16.50	3.50	13.00	3.410	44.32	17.00	9.778	1.96	0.0152	0.0212	44.32
	10	25	1.0155	15.50	3.50	12.00	3.409	40.91	16.00	9.958	1.00	0.0151	0.0151	40.91
	15	25	1.0150	15.00	3.50	11.50	3.409	39.21	15.50	10.048	0.67	0.0151	0.0123	39.21
	30	25	1.0140	14.00	3.50	10.50	3.410	35.80	14.50	10.228	0.34	0.0152	0.0089	35.80
	60	25	1.0125	12.50	3.50	9.00	3.410	30.69	13.00	10.498	0.17	0.0152	0.0063	30.69
	120	25	1.0110	11.00	3.50	7.50	3.410	25.58	11.50	10.768	0.09	0.0153	0.0046	25.58
	240	25	1.0075	7.50	3.50	4.00	3.410	13.64	8.00	11.398	0.0475	0.0153	0.0033	13.64
	480	25	1.0060	6.00	3.50	2.50	3.409	8.52	6.50	11.668	0.0243	0.0151	0.0024	8.52
	1440	25	1.0040	4.00	3.50	0.50	3.410	1.71	4.50	12.028	0.0084	0.0153	0.0014	1.71

Pashupati Drilling Geo-Technical Services Pvt. Ltd.

GRADATION TEST

Location : Tundikhel, Kathmandu, Nepal

Bore Hole No.: BH - 04 **Depth of Sample :** 40.5 UD

Total wt. = **96.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	0.0	0.00	100.00
0.15	0.0	0.00	100.00
0.075	1.5	1.50	98.45

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	1.55
0.075--0.005	mm	**Silt**	56.90
<0.005	mm	**Clay**	41.54

K1 = [Gs xYc/(Gs-1)]x[100/Ws]

K_{24} = (2.2*0.99712/(2.2-1))*(100/50)

= 3.612

K_2 = SQRT(30xn/(980*(Ys - Yw))

$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))

0.01517

Hydrometer Analysis:-

Hydrometer type :

Dispersing agent $NaPO_3$

Zero correction :

SG of solids : 2.233

Amount : 4 % in 125 ml

Meniscus correction : 0.5

rw = 0.998

Wt. Of soil, Ws = 50.00 gms.

Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0240	24.00	3.50	20.50	3.612	74.04	24.50	9.390	9.39	0.0152	0.0465	74.04
	2	25	1.0230	23.00	3.50	19.50	3.612	70.43	23.50	9.570	4.79	0.0152	0.0332	70.43
	3	25	1.0210	21.00	3.50	17.50	3.612	63.20	21.50	8.968	2.99	0.0152	0.0262	63.20
	5	25	1.0210	21.00	3.50	17.50	3.612	63.20	21.50	8.968	1.79	0.0152	0.0203	63.20
	10	25	1.0205	20.50	3.50	17.00	3.611	61.40	21.00	9.058	0.91	0.0151	0.0144	61.40
	15	25	1.0200	20.00	3.50	16.50	3.611	59.59	20.50	9.148	0.61	0.0151	0.0118	59.59
	30	25	1.0190	19.00	3.50	15.50	3.612	55.98	19.50	9.328	0.31	0.0152	0.0085	55.98
	60	25	1.0170	17.00	3.50	13.50	3.612	48.76	17.50	9.688	0.16	0.0152	0.0061	48.76
	120	25	1.0150	15.00	3.50	11.50	3.612	41.54	15.50	10.048	0.08	0.0153	0.0044	41.54
	240	25	1.0120	12.00	3.50	8.50	3.612	30.71	12.50	10.588	0.0441	0.0153	0.0032	30.71
	480	25	1.0100	10.00	3.50	6.50	3.611	23.47	10.50	10.948	0.0228	0.0151	0.0023	23.47
	1440	25	1.0070	7.00	3.50	3.50	3.612	12.64	7.50	11.488	0.0080	0.0153	0.0014	12.64

Geo-Technical Services Pvt. Ltd. Pashupati Dham

GRADATION TEST

Location : Tripureshwor, Kathmandu, Nepal
Bore Hole No.: BH - 05 **Depth of Sample :** 13.5 UD
Total wt. = **142.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	7.0	7.00	95.09
0.85	2.8	9.80	93.12
0.6	7.0	16.80	88.21
0.425	1.5	18.30	87.16
0.3	1.0	19.30	86.46
0.15	1.0	20.30	85.75
0.075	1.0	21.30	85.05

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	12.84
0.425--0.075	mm	**Fine**	2.11
0.075--0.005	mm	**Silt**	64.02
<0.005	mm	**Clay**	21.03

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.505
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.320
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0210	21.00	3.00	18.00	3.505	63.09	21.50	9.930	9.93	0.0152	0.0478	63.09
	2	25	1.0190	19.00	3.00	16.00	3.505	56.08	19.50	10.290	5.15	0.0152	0.0344	56.08
	3	25	1.0175	17.50	3.00	14.50	3.505	50.82	18.00	9.598	3.20	0.0152	0.0271	50.82
	5	25	1.0150	15.00	3.00	12.00	3.505	42.06	15.50	10.048	2.01	0.0152	0.0215	42.06
	10	25	1.0140	14.00	3.00	11.00	3.505	38.55	14.50	10.228	1.02	0.0151	0.0153	38.55
	15	25	1.0130	13.00	3.00	10.00	3.505	35.05	13.50	10.408	0.69	0.0151	0.0126	35.05
	30	25	1.0115	11.50	3.00	8.50	3.505	29.79	12.00	10.678	0.36	0.0152	0.0090	29.79
	60	25	1.0100	10.00	3.00	7.00	3.505	24.54	10.50	10.948	0.18	0.0152	0.0065	24.54
	120	25	1.0090	9.00	3.00	6.00	3.506	21.03	9.50	11.128	0.09	0.0153	0.0046	21.03
	240	25	1.0085	8.50	3.00	5.50	3.506	19.28	9.00	11.218	0.0467	0.0153	0.0033	19.28
	480	25	1.0070	7.00	3.00	4.00	3.505	14.02	7.50	11.488	0.0239	0.0151	0.0023	14.02
	1440	25	1.0070	7.00	3.00	4.00	3.506	14.02	7.50	11.488	0.0080	0.0153	0.0014	14.02

Geo-Technical Services Pvt. Ltd. Pashupati Drilling

GRADATION TEST

Location : Tripureshwor, Kathmandu, Nepal
Bore Hole No.: BH - 05 **Depth of Sample :** 23.5 UD
Total wt. = **61.5** gm

Dia,mm	Retain in gm.	Cum. Rtn., gm.	Passing %
20	0.0	0.00	100.00
16	0.0	0.00	100.00
4.75	0.0	0.00	100.00
2.36	0.0	0.00	100.00
2	0.0	0.00	100.00
1.18	0.0	0.00	100.00
0.85	0.0	0.00	100.00
0.6	0.0	0.00	100.00
0.425	0.0	0.00	100.00
0.3	0.0	0.00	100.00
0.15	0.0	0.00	100.00
0.075	2.5	2.50	95.93

ASTM classification

>4.75	mm	**gravel**	0.00
4.75--0.425	mm	**Coarse to mediur**	0.00
0.425--0.075	mm	**Fine**	4.07
0.075--0.005	mm	**Silt**	69.56
<0.005	mm	**Clay**	26.38

K1 = [Gs xYc/(Gs-1)]x[100/Ws]
K_{24} = (2.2*0.99712/(2.2-1))*(100/50)
= 3.517
K_2 = SQRT(30xn/(980*(Ys - Yw))
$K_{24.5}$ = SQRT(30x0.00904/(980*(2.2-0.99712))
0.01517

Hydrometer Analysis:-

Hydrometer type :
Dispersing agent $NaPO_3$
Zero correction :
SG of solids : 2.310
Amount : 4 % in 125 ml
Meniscus correction : 0.5
rw = 0.998
Wt. Of soil, Ws = 50.00 gms.
Passing by .075mm 100.00 %

Date	Elapsed time (t) minute	Temp ^0C	Actual Hydro. reading	Actual Hyd. reading R 1000(rw-1)	Hyd. Reading in water Rw 1000(rw-1)	R - Rw	K1	% Finer K1*(R-Rw)	Hyd. Corr.for meniscus only R	Effective length L cm	L/t	K2	Diameter (D), mm K2 * Sqrt(L/t)	Actual % Finer
	1	25	1.0190	19.00	3.00	16.00	3.517	56.26	19.50	10.290	10.29	0.0152	0.0487	56.26
	2	25	1.0170	17.00	3.00	14.00	3.517	49.23	17.50	10.650	5.33	0.0152	0.0350	49.23
	3	25	1.0160	16.00	3.00	13.00	3.517	45.72	16.50	9.868	3.29	0.0152	0.0275	45.72
	5	25	1.0145	14.50	3.00	11.50	3.517	40.44	15.00	10.138	2.03	0.0152	0.0216	40.44
	10	25	1.0140	14.00	3.00	11.00	3.516	38.68	14.50	10.228	1.02	0.0151	0.0153	38.68
	15	25	1.0130	13.00	3.00	10.00	3.516	35.16	13.50	10.408	0.69	0.0151	0.0126	35.16
	30	25	1.0125	12.50	3.00	9.50	3.517	33.41	13.00	10.498	0.35	0.0152	0.0090	33.41
	60	25	1.0110	11.00	3.00	8.00	3.517	28.13	11.50	10.768	0.18	0.0152	0.0064	28.13
	120	25	1.0105	10.50	3.00	7.50	3.517	26.38	11.00	10.858	0.09	0.0153	0.0046	26.38
	240	25	1.0100	10.00	3.00	7.00	3.517	24.62	10.50	10.948	0.0456	0.0153	0.0033	24.62
	480	25	1.0095	9.50	3.00	6.50	3.516	22.86	10.00	11.038	0.0230	0.0151	0.0023	22.86
	1440	25	1.0085	8.50	3.00	5.50	3.517	19.35	9.00	11.218	0.0078	0.0153	0.0013	19.35

Geo Technical Services Pvt. Ltd. Pashupati Dip

ANNEX - E
METHANE GAS TEST RESULTS

METHANE GAS TEST

Date: April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Manahara, Kathmandu, Nepal

Gas Analyzer.: Biogas 5000, Geotech

Bore Hole No.: BH - 01

S. No.	Paramenters	Chemical Formula	Observed Value (%)	Remarks
1	Methane	CH_4	4.7	
2	Carbon Dioxide	CO_2	0.0	
3	Oxygen	O_2	16.5	
4	Balance (Other Gases)	-	78.8	

METHANE GAS TEST

Date: April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tinkune Park, Kathmandu, Nepal

Gas Analyzer.: Biogas 5000, Geotech

Bore Hole No.: BH - 02

S. No.	Paramenters	Chemical Formula	Observed Value (%)	Remarks
1	Methane	CH_4	9.2	
2	Carbon Dioxide	CO_2	0.0	
3	Oxygen	O_2	15.7	
4	Balance (Other Gases)	-	75.0	

METHANE GAS TEST

Date: April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: New Baneshwor, Kathmandu, Nepal

Gas Analyzer.: Biogas 5000, Geotech

Bore Hole No.: BH - 03

S. No.	Paramenters	Chemical Formula	Observed Value (%)	Remarks
1	Methane	CH_4	0.7	
2	Carbon Dioxide	CO_2	0.0	
3	Oxygen	O_2	13.6	
4	Balance (Other Gases)	-	85.7	

METHANE GAS TEST

Date: April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tundikhel, Kathmandu, Nepal

Gas Analyzer.: Biogas 5000, Geotech

Bore Hole No.: BH - 04

S. No.	Paramenters	Chemical Formula	Observed Value (%)	Remarks
1	Methane	CH_4	17.6	
2	Carbon Dioxide	CO_2	9.7	
3	Oxygen	O_2	13.9	
4	Balance (Other Gases)	-	58.80	

METHANE GAS TEST

Date: April 2019

Project: Geological Survey Under Data Collection Survey on Urban Transport in Kathmandu Valley

Client: JICA Study Team J/V of Oriental Consultants Global Co., Ltd., & PADECOCo., LTD,, Japan

Location: Tripureshwor, Kathmandu, Nepal

Gas Analyzer.: Biogas 5000, Geotech

Bore Hole No.: BH - 05

S. No.	Paramenters	Chemical Formula	Observed Value (%)	Remarks
1	Methane	CH_4	58.4	
2	Carbon Dioxide	CO_2	28.2	
3	Oxygen	O_2	1.8	
4	Balance (Other Gases)	-	11.6	

ANNEX - F

GEODETIC SURVEY REPORT

GEODETIC MEASUREMENT OF THE DRILLING WORKS

Project Description

The project site is located at Bagmati Zone, Kathmandu District.

Figure 1. Location Map of Geological Survey

Figure 2 Control Point Location on Google Earth

The purpose of this job is to provide control point to precede survey for design and implementation of the project sites.

Approach Methodology and Result

The Pentax G3100-R2 GPS receiver uses which measures GPS, GLONASS and BEIDOU constellatieons for robust and accurate satellite positioning. The advanced receiver technology includes Receiver Autonomous Integrity Monitoring Multipath Estimation and a standard out put rate up to 25 Hz. The G3100-R2 combination of a GNSS receiver with a matched internal antenna provides an integrated product with optimal performance that is ready for use at turn-on.

Figure 3 Pentax G3100-R2 Receiver

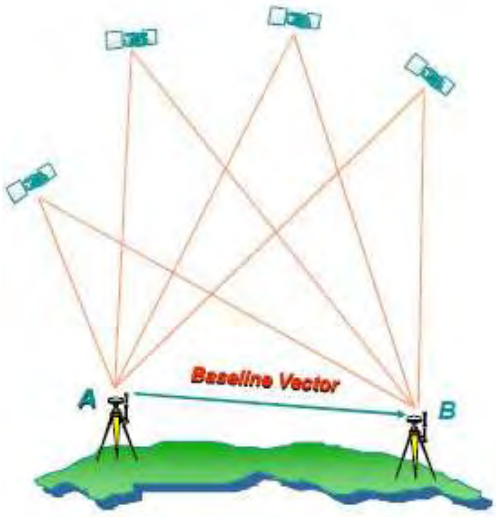


Figure 4 DGPS Survey Principle

Once the survey crew travelled to the site they mounted on concrete pillar as per client requirement and start the GPS survey using STATIC method. There are three set of GPS receiver set over the mounted pillar as per required time. Static GPS observations were performed by qualified and trained surveyor. A two-meter fixed height tripod was used to eliminate human error that could have been introduced by miss-measurement of the GPS antenna heights. Information about the static GPS session was referenced on a GPS Log sheet and made a part of this report.

During each GPS session, a raw data file was created on the GPS receiver. The monument name, Julian date, session number and antenna height was keyed into the receiver. The survey technician completed a GPS log sheet, while in the field, to document information about the survey as well as other pertinent monument details. Information on the log sheets included the monument stamping, reference sketch and reference measurements, actual survey start and stop times, the GPS antenna height measurements, weather conditions, satellite information as well as any problems that may be encountered during the survey. The log sheets also serve as a quality control check for the data processor when the data is downloaded from the GPS receiver, confirming that the monument names and antennas heights were keyed in correctly.

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

In this project following approaches are adopted:

a. Determination of precise WGS84 coordinates of Base station (B001) at the beginning of the project with 12:50 hours observation and differential solution using international GPS Station (IGS station) LHAZ.

b. Checking the accuracy of processing with various online PPP (Precise Point Positioning) processing services (CSRS Canada, AUSPOS Australia and OPUS USA).

c. Processing of the other control points with respect to base point with double difference and network adjustment.

d. Transformation of Ground control points (GCPs) from WGS 84 TO Modified Universe Transverse Mercator (MUTM) system of 87 degree central meridian using transformation parameter published by DOS.

GPS Data Downloading, Processing & Adjustments

Upon completing the static GPS survey, GPS log sheets were checked and compared to the data files on the receivers. The daily GPS raw data files were downloaded into the project created in Trimble Business Center (TBC) software and converted to RINEX format for uploading to the NGS Online Positioning User Service (OPUS) Program. The OPUS solutions were combined in a spreadsheet.

All results of the settlement plate survey were tabulated to include date of survey, elevation and difference of elevation for each survey event compared to the initial elevation.

Results:

The software is calculated the coordinate in UTM 45 North system. Later we transform these coordinate into MUTM central meridian 84 degree. The output results are tabulated below.

Table –1: COORDINATE SYSTEM: **WGS1984 UTM ZONE 45 NORTH**

S. No	Easting	Northing	Elevation	latitude	Longitude	Remarks
1	337083.2	3063422	1294.385	N27°41'06.69142"	E85°20'52.59952"	Base Tinkune
2	338787.8	3063531	1299.17	N27°41'10.97186"	E85°21'54.73590"	Manohara P-1
3	337206.8	3063286	1296.711	N27°41'02.32075"	E85°20'57.17725"	Tinkune P-2
4	334252.9	3064572	1286.187	N27°41'42.80394"	E85°19'08.76785"	Thapathali TCP-1 P-3
5	333743.8	3064495	1290.748	N27°41'40.07089"	E85°18'50.23112"	Tripureshwor P-4
6	333837	3065611	1298.592	N27°42'16.37331"	E85°18'53.07616"	Tundikhel P-5
7	335769.8	3063748	1305.686	N27°41'16.72916"	E85°20'04.52069"	New BaneshworP-6

Table – 2: COORDINATE SYSTEM: **MUTM CENTRAL MERIDIAN 84 DEGREE**

S. No	Easting	Northing	Elevation	latitude	Longitude	Remarks
1	633181	3063678	1294.385	N27°41'06.69142"	E85°20'52.59952"	Base Tinkune
2	634882.4	3063828	1299.17	N27°41'10.97186"	E85°21'54.73590"	Manohara P-1
3	633307.9	3063545	1296.711	N27°41'02.32075"	E85°20'57.17725"	Tinkune P-2
4	630323.5	3064759	1286.187	N27°41'42.80394"	E85°19'08.76785"	Thapathali TCP-1 P-3
5	629816.5	3064669	1290.748	N27°41'40.07089"	E85°18'50.23112"	Tripureshwor P-4
6	629882.5	3065788	1298.592	N27°42'16.37331"	E85°18'53.07616"	Tundikhel P-5
7	631860	3063972	1305.686	N27°41'16.72916"	E85°20'04.52069"	New BaneshworP-6

Baseline Processing Report

Project file data		Coordinate System	
Name:		Name:	NEPAL
Size:	80 KB	Datum:	WGS_MUTM
Modified:	5/15/2019 4:09:33 PM (UTC:5)	Zone:	WGS84_TO_MUTM84
Time zone:	Nepal Standard Time	Geoid:	EGM2008
Reference number:		Vertical datum:	
Description:		Calibrated site:	Default
Comment 1:			
Comment 2:			
Comment 3:			

Additional Coordinate System Details

Local Site Settings			
Project latitude:	N27°41'05.31233"	Ground scale factor:	1.00008089669613
Project longitude:	E85°21'01.20861"	False northing offset:	0.000
Project height:	1275.400	False easting offset:	0.000

Processing Summary

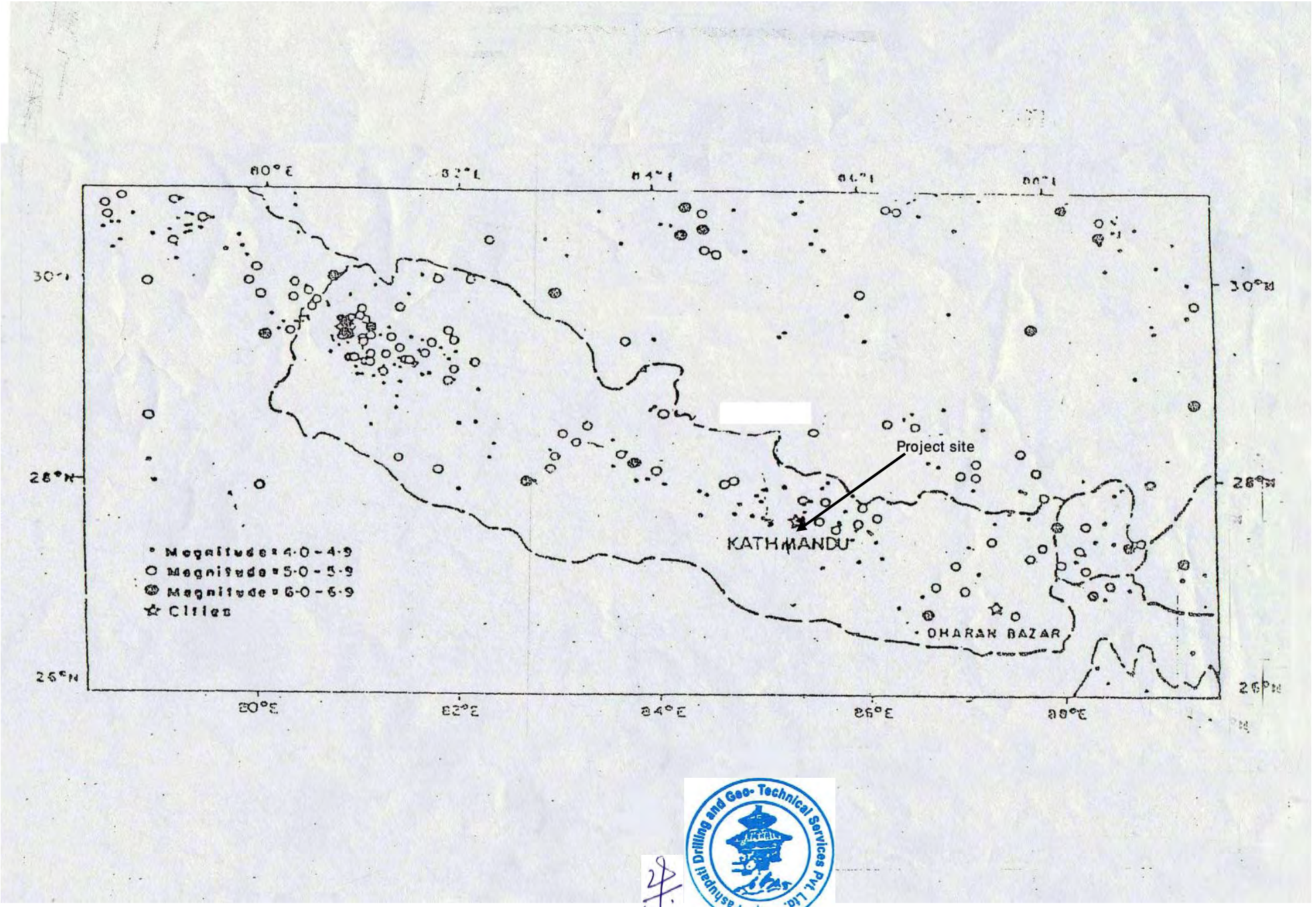
Observation	From	To	Solution Type	H. Prec. (Meter)	V. Prec. (Meter)	Geodetic Az.	Ellipsoid Dist. (Meter)	Δ Height (Meter)
BASE --- P002 (B4)	BASE	P002	Fixed	0.003	0.004	137°00'19"	183.942	2.314
BASE --- P004 (B10)	BASE	P004	Fixed	0.010	0.013	287°02'47"	3506.854	-3.698
BASE --- P003 (B5)	BASE	P003	Fixed	0.008	0.013	291°20'58"	3054.483	-8.215
BASE --- P006 (B6)	BASE	P006	Fixed	0.007	0.047	283°12'13"	1353.171	11.265
BASE --- P005 (B12)	BASE	P005	Fixed	0.007	0.036	303°13'58"	3914.763	4.314
P002 --- P001 (B7)	P002	P001	Fixed	0.003	0.005	80°24'51"	1599.526	2.596
P004 --- P003 (B9)	P004	P003	Fixed	0.010	0.013	80°35'35"	514.824	-4.494
BASE --- P001 (B8)	BASE	P001	Fixed	0.003	0.009	85°34'20"	1707.722	4.912

Acceptance Summary

Processed	Passed	Flag		Fail	
8	8	0		0	

ANNEX - G

FIGURE



Pashupati Drilling and Geo- Technical Services Pvt. Ltd.

ANNEX - H

PHOTOGRAPHS

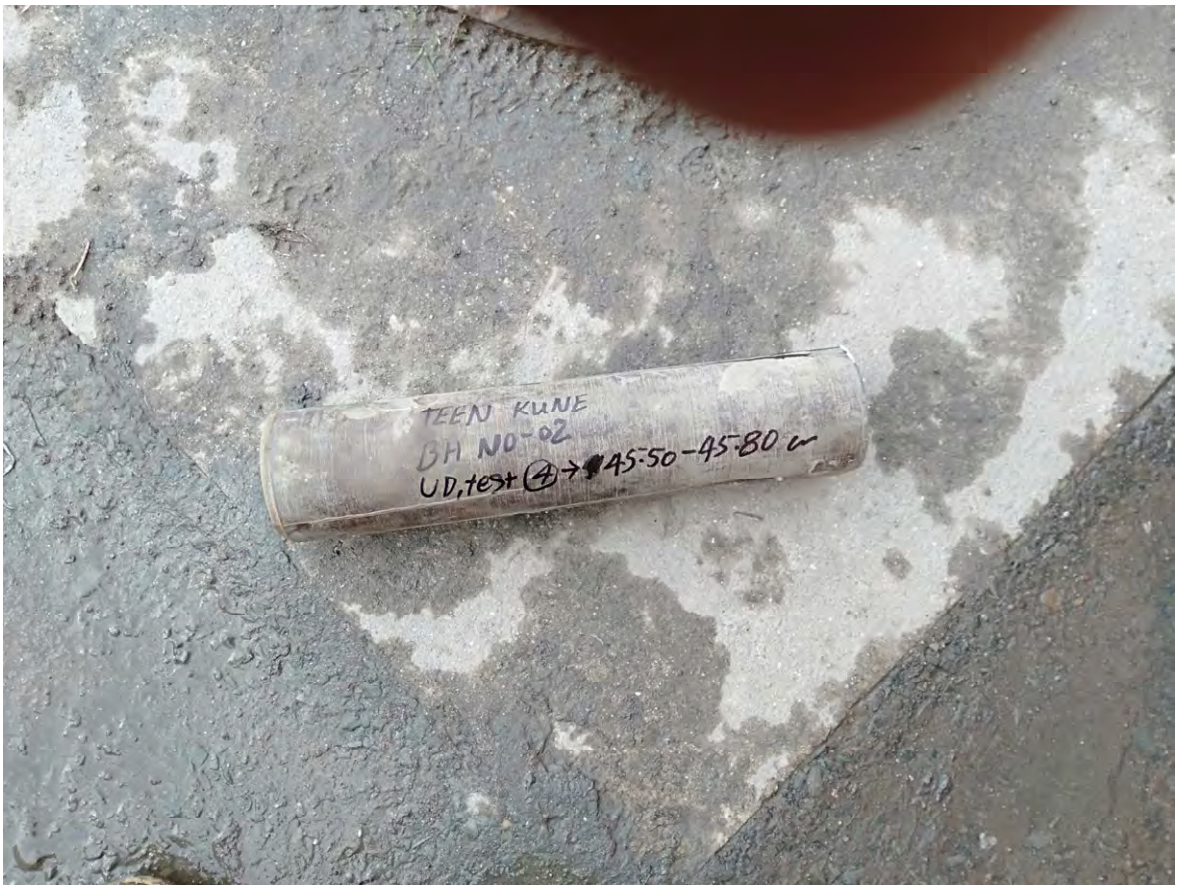
Drilling a Hole by Rotary Drilling Method

Pashupati Drilling and Geo- Technical Services Pvt. Ltd.

Conducting SPT/DCPT Test for getting (N) Value by Dropping a 63.5 kg Hammer from 750mm height

Retrieving Soil Samples through SPT Tubes

Pashupati Drilling and Geo- Technical Services Pvt. Ltd.



Preserving UD Samples in a UD Samplers

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

Preserving Soil Samples in a Core Boxes

Pashupati Drilling and Geo-Technical Services Pvt. Ltd.

Conducting Methane Gas Test

Conducting Geodetic Survey Works