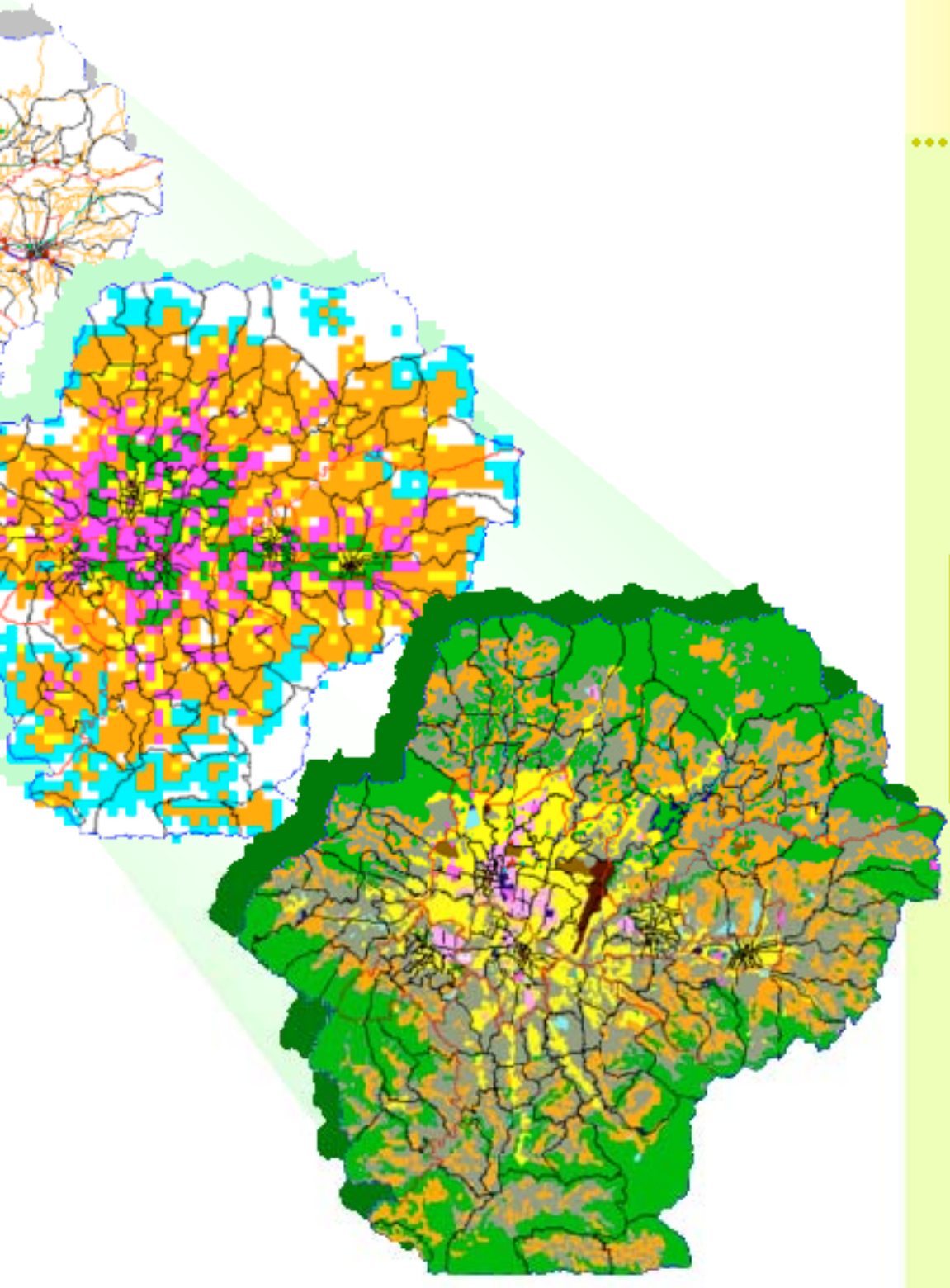
No.

Japan International Cooperation Agency (JICA)

Ministry of Home Affairs, HMG of Nepal

The Study on Earthquake Disaster Mitigation

In the Kathmandu Valley
Kingdom of Nepal



Final Report

Vol. I	II	III	IV	V
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March, 2002

Nippon Koei Co., LTD.
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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF HOME AFFAIRS, HIS MAJESTY'S GOVERNMENT OF NEPAL

THE STUDY
ON
EARTHQUAKE DISASTER MITIGATION
IN
THE KATHMANDU VALLEY, KINGDOM OF NEPAL

FINAL REPORT

VOLUME IV

APPENDIX

MARCH 2002

NIPPON KOEI CO., LTD.
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Composition of the Final Report

Volume I : SUMMARY

Volume II : MAIN REPORT (1/2)
BLUEPRINT FOR KATHMANDU VALLEY EARTHQUAKE DISASTER MITIGATION

Volume III : MAIN REPORT (2/2)
EARTHQUAKE DISASTER ASSESSMENT AND DATABASE SYSTEM

Volume IV : APPENDIX

Volume V : SUMMARY in Japanese

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October, 2001

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I General

I-1 DISASTER MANAGEMENT SYSTEMS IN THE WORLD

I-1 DISASTER MANAGEMENT SYSTEMS IN THE WORLD

The Evolving Philosophical Approach to Disaster Management

The laws, institutions, and systems for disaster management that have developed in various parts of the world follow certain patterns but no universal model. The traditional approach has been to wait until a disaster occurs, then work night and day to deal with the aftermath. Certain societies and religious beliefs foster a fatalistic attitude toward disasters as expressions of "the will of god." But current trends, popularised during the International Decade for Natural Disaster Reduction, are focusing more emphasis on pre-disaster mitigation, linking mitigation with ongoing development activities, and forming partnerships between national and local governments and non-governmental organisations to promote mitigation and preparedness. A shift is occurring from strictly “top down” approaches to a combination of “top down” and “bottom up” approaches. National government resources, guidance, leadership, commitment, and technical assistance are needed, while local governments and communities must contribute the political will to focus attention and scarce resources on disaster preparedness and risk reduction.

The Legal/Governmental Context

The disaster management institutions and systems that have evolved in countries with a historical tradition of highly centralised government are themselves highly centralised and dependent upon national government institutions and capabilities. In countries where there is a stronger tradition of local power, authority, and autonomy, disaster management systems tend to be more locally driven, relying on support from higher levels of government.

Nepal has a very centralised administrative structure, with most responsibilities and resources residing with the ministries of His Majesty's Government. Districts are administrative subdivisions of the national government and the chief administrative officer of the district is an appointee and employee of the national government's Ministry of Home Affairs. In many or perhaps most developing countries, including Nepal, local governments generally have not traditionally possessed the authorities, resources, expertise, and degree of political commitment necessary to deal effectively with disaster risk.

The Japanese legal and planning framework for disaster management is especially

instructive and useful for this project, in particular because Japanese law has responded to scientific advances, to the lessons and experience of the Great Hanshin-Awaji Earthquake, and to the special needs of specific key regions. While federal law in the United States is evolving with changes in strategies and approaches, it has not singled out specific earthquake-prone regions for special treatment. This approach from Japan offers a viable model for an earthquake-specific structure and legislation for the Kathmandu Valley.

Laws (Legal Basis)

Disaster legislation in the United States tends to concentrate either on preparedness, response and relief, or on risk reduction (mitigation), rather than approach the topic in a holistic manner. Nevertheless, there are strong elements, particularly in some state and local laws, that can be useful in outlining a suggested draft law for Nepal, if desired. For instance, the U.S. Congress enacted the National Earthquake Hazards Reduction Program (NEHRP) by law in 1977 to foster the development and implementation of seismic design and construction standards and techniques. In the U.S., states and local governments are permitted to enact their own disaster management legislation. California enacted a law specifically to address earthquake hazard mitigation, the California Earthquake Hazards Reduction Act (1985). This statute required the state's Seismic Safety Commission to prepare and administer a program setting forth priorities, funding sources, amounts, schedules, and other resources needed to reduce statewide earthquake hazards significantly by the year 2001.

In developing countries, comprehensive disaster management laws are rare. Typically, the disaster laws pertain strictly to the management of emergencies. These laws establish the legal basis for declaration of emergency or disaster in the country, exercise of emergency powers by the Government, and provision of relief and assistance to victims. These laws may or may not establish a "disaster council" or other body to coordinate disaster response. Nevertheless, both Colombia and the People's Republic of China provide strong examples of holistic, comprehensive disaster management laws that can serve as reference points for the case of Nepal. China’s Law on Earthquake Disaster Preparedness and Reduction was approved by the National People's Congress and signed by the President of the Republic, effective March 1, 1998. The law provides a holistic approach to disaster management, with stress on prevention and linkages to the state plan of national economy and social development. Responsibility for leadership is ascribed to all levels of government.

When the disaster management law of a country is obsolete, new institutional arrangements and plans that overcome the deficiencies of the law could be developed, or new legislation could be proposed. By creating the new system (institutional arrangements and plans) with the participation and support of the stakeholders, a firm base of support for a new legislative mandate can emerge.

Roles and Responsibilities

Assignments of functions and responsibilities among ministries and other organisations need to be accepted by all the involved entities and formalised explicitly through disaster legislation, implementing regulations, or a national disaster/emergency management plan that carries the force of law. In the case of Nepal, this is particularly important in light of the provision that assigns to the Ministry of Home "all other functions of HMG which have not been specifically prescribed for any other Ministry or Department." In the United States, at the federal level, the Federal Response Plan (FRP) assigns responsibilities to federal departments and agencies and to the American Red Cross, and each agency head affixed his/her signature to the plan. In the State of California, responsibilities are assigned in a state plan, whereas in the City of Los Angeles assignments are made by local law. In Colombia, assignments are made in a national plan that has the force of law.

Institutions (Nodal Agencies)

The Federal Emergency Management Agency became the nodal agency for disaster management in the U.S. in 1979. In the mid- to late-1990s, the agency emerged as a strong advocate for mitigation rather than relief, and began influencing Congress and state and local governments to focus on and invest in mitigation. The case of FEMA demonstrates the importance of:

- Earning the confidence and support of the chief executive (president, prime minister), other departments/ministries and stakeholders
- Developing high professional competence that commands respect
- Politically skilled and astute leadership.

Most U.S. states have some form of a department or division or office of emergency management or emergency services or civil defence. In California, there is also a separate and very effective state organisation specifically for seismic risk reduction, the California Seismic Safety Commission. Canada and

New Zealand have both recently taken steps to expand the role of their national disaster management agencies to incorporate a stronger focus on mitigation and integrated risk management. In New Zealand, a Review of Emergency Services completed in 1996 led the New Zealand Government to determine the need for change in the country's emergency management arrangements. And in February 2001, the Prime Minister of Canada announced the creation of a new Office of Critical Infrastructure Protection and Emergency Preparedness.

In Colombia, the City of Bogota has a very active, well-financed and well-resourced Department for the Prevention and Attention to Emergencies. The department's programs include public awareness and education, development of a state-of-the-art GIS and internet-based disaster management information system, and relocation of neighbourhoods from hazard-prone sites to new, safer locations. But in Sri Lanka, the nodal agency for disaster management is the agency charged with responsibility for disaster relief, the Ministry of Social Services, which is not a powerful ministry. When the officials responsible for disaster management in Social Services attempted to get a disaster law enacted to centralise authority for disaster planning with the Ministry, another Ministry (Defense) opposed it.

Inter-Institutional Arrangements (Coordinating Bodies)

A common inter-institutional arrangement to provide for inter-agency coordination is a standing inter-agency committee or council that meets regularly and pursues an action agenda. Most such committees or councils are concerned primarily or exclusively with coordinating emergency preparedness and response activities, rather than being oriented toward mitigation and/or reconstruction programs. Typically the greatest difficulty with such committees or councils is sustaining their interest in the absence of a disaster. Nevertheless, successful models do exist. For instance, Japan’s Central Disaster Prevention Council is chaired by the Prime Minister, with the Minister of State and other officials and technical experts as members. The CDPC deliberates important matters concerning disaster prevention including formulation and promoting the execution of the Basic Plan for Disaster Prevention. In the U.S., the Catastrophic Disaster Response Group handles policy issues related to federal response to a disaster and addresses response issues and problems which require national-level decisions or policy direction.

In Colombia there is a National Committee for Prevention and Attention to

Disasters, supported by two other national committees, a National Technical Committee (focused primarily on risk assessment and mitigation) and a National Operational Committee (focused primarily on preparedness, response and relief). The Colombian national system was created by law in 1988. A similar system is being proposed for the Dominican Republic.

National Mitigation or Risk Management Plans

The General Principles Relating to Countermeasures for Earthquakes Directly Below the South-Kanto Region (1992, 1998) provides a strong model for a Kathmandu Valley earthquake mitigation plan. It is notable for its mitigation focus and for recognizing the need for inter-governmental cooperation and action on the part of local as well as national governmental entities. The general categories and proposed action areas of the General Principles are quite similar to those included in Colombia's Decree No. 93 of 1997 and National Plan for Prevention and Attention to Disasters.

The Colombian plan and the draft Dominican Republic plan patterned after it also both include a useful matrix which lists the agencies responsible for each program or action item. By combining the ideas from the General Principles and the Colombian, Dominican, and California plans described in the report, along with the two existing Nepalese plans, there is more than ample input for an up-to-date, holistic plan for the Kathmandu Valley.

National Emergency Plans

The best emergency plans are simple, straightforward, clearly understood and accepted by all parties, and fit with normal duties and expectations. They take into account existing informal relationships and lines of communication. Key elements of emergency plans include the assignment of responsibilities and authorities and the establishment of systems for command and control, communications, coordination, and collection and dissemination of information.

The U.S. Federal Response Plan (FRP) often serves as a model for the national plans of other countries. A major strength of the plan is its clarity regarding assignments of responsibilities and mechanisms for decision-making and inter-agency coordination. The FRP relates only to the federal component of response to a disaster. U.S. state and local governments also have their own emergency plans, as do many large businesses. The California Emergency Plan

is relatively simple and straightforward and more concise than some emergency plans. The City of Los Angeles Emergency Operations Master Plan and Procedures incorporates many of the same concepts, operational approaches, and assignments of functions of the federal and state plans, but it also reflects the specific organisation, resources, and needs of the City.

The emergency plans of developing countries vary dramatically. The Metro Manila Emergency Preparedness Plan and Earthquake Preparedness Plan are each only a few pages long. They essentially provide merely a framework for planning and preparedness, and they make general assignments of responsibilities. The draft plan of Sri Lanka, on the other hand, is hundreds of pages long, and much of the text is based on a similarly voluminous plan from the State of Maharashtra, India, which includes entire resource inventories. The National Emergency Plan of the Dominican Republic is based to some extent on the Federal Response Plan and Los Angeles Plan, and includes matrices of functions and responsibilities and lists of responsibilities by agency.

I-2 Building Code History in Japan

I-2 Building Code History in Japan

In 1868, Japan changed its political system from a feudal state to a constitutional monarchy. The new government made an extensive effort to introduce Western civilization, science and engineering. In the architectural field, Mr. Josiah Conder, a British architect, was invited to teach at Technical College in Tokyo as a Professor of Architecture. However, it had been a long and hard way until the enactment of the Building Standard Law in Japan on 1950.

The 1891 Nobi earthquake and the 1923 Great Kanto earthquake that caused casualties of 100,000 people and burnt or collapse over 100,000 houses mainly for wooden houses. This was the first trigger movement for the regulation of buildings in Japan. Masonry structure, which introduced from Europe and the United States, had been constructed as noncombustible structures in 1890 ages. The 1891 Nobi earthquake caused large damage on masonry structures. It became clear that weak point was in the lack of earthquake resistance on the masonry structure. Numbers of research was carried out for increasing the earthquake resistance of brick structure. So that the buildings, which reinforced the brick by the steel flamed, were built.

However, the 1923 Great Kanto earthquake was also reported that more than 6,000 brick masonry buildings and 1,400 stone masonry buildings were totally collapsed. The damage ratio was over 80% in the severely suffered area. The evaluation of the masonry building was inferior as seismic resistance structure. Masonry structures have disappeared at least in building in Japan after the earthquake.

The new technology introducing the RC and SRC structure has entered from Europe and the United States from 1897. Especially, the RC building was noticed in the excellent structure against in fire valuable. It was verified that the 1906 San Francisco earthquake arose and that it is excellent not only in fire valuable but also in earthquake resistance. The proper building structure that avoids spreading the disaster of earthquake and fire in Japan seemed to come to be the RC construction, although so far the most abounding structure is still wooden ones, because of the traditional life style, cost and available resources.

Before the enactment of the Building Standard Law in Japan on 1950, there were several severe earthquakes struck and various efforts had been implemented at several prefectures and metropolitan cooperating with various architects and structural engineers. There have been various variations of regulation values and improvement at the case of disastrous earthquake during the years.

Finally, the Building Standard Law in Japan firstly enacted on 1950 by the National Government, considering former knowledge and the 1948 Fukui Earthquake that caused tremendous damages to wooden houses. Thus after this enactment, wooden houses, which is the most popular dwellings in Japan, became improved and strengthened. And so far, a little by little, Japanese wooden houses have been improved through the lessons from disastrous earthquakes that caused damage to them.

Table 2.2.5-4 Major earthquake and improvements of Japan design system

A.D.	Tendency of Design System			A.D.	Earthquake
1868	Japan changed its political system to a constitutional monarchy	, without the legislation of the earthquake resistant design	Without Regulat		
1877	Tokyo Univ. architecture division originally established				
1880	Seismological Society of Japan originally established			1880	Yokohama Eq.*M* 6
	Masonry building mode from Europe and America began				
1886	Architectural Institute of Japan(AIJ) originally established			1891	Nobi Eq.*M* 8
	Contents of Publications of the Imperial Eq. Investigate Committee				
1892	established				
1900	Technology import of the RC and SRC Structure				
1913	Architecture regulation plan of the Tokyo City				
1916	"House seismic structure theory" publication				
	Proposal of the seismic intensity method				
1919	"Urban district construction method" promulgation				
1920	"Structure act enforcement regulation" promulgation				
1923	Earthquake□resistant design building construction		Regulation by Prefecture/Metropolitan	1923	Kantho Eq.*M* 7.9
1924	"**Structure act enforcement regulation**"□revised	Allowable stress design method 0.1 lateral seismic factor			
	0.1 lateral seismic factor				
	AIJ "**structural strength design code**" enactment				
1930	Flexible structure vs. Rigid structure				
1932	"**Structure act enforcement regulation**"□revised				
1933	publication				
	"**Structure act enforcement regulation**"□revised				
1937	**Allowable stress design method** regulation				
	Building seismic structure point/0.3-0.4 lateral seismic factor				
1941	**Temporary Japan standard**/The wartime standard				
1944	0.15 lateral seismic factor			1944	Tonankai Eq.M7.9
1945	End of the World War II			1945	Mikawa Eq.M6.8
	Japan architecture standard/ architectur 3001			1946	Nankai Eq.M8
1947	0.2 lateral seismic factor	0.2 lateral seismic factor Dynamic Analysis for High Rise Building		1948	Fukui Eq.*M* 7.1
	"**Building Standard Law** /structure regulation "		National Law Regulation		
	defined the structural standard				
1950	0.2 lateral seismic factor				
	"**Seismic Region Coefficient Enactment**" published				
1952	"**Building Standard Law**/structure regulation"□revised				
1959	"**Building Standard Law**"□revised				
1961	"**Building Standard Law**"□revised				
1963	"**Building Standard Law**/structure regulation"□revised				
1964	"High Rise Building Technical Guide Line" published			1964	Niigata Eq.*M* 7.5
	"**Building Standard Law**" revised				
1965	"**Building Standard Law**" revised			1968	Tokachi-oki Eq.*M* 7.9
1971	/RC colum hoop rain force interval to be reduced	Ductility		1971	SanFernando Eq.*M* 6.4
1972	"New Anti-seismic Design Code" Project start				
1977	"New Anti-seismic Design Code" Project end				
	"**Building Standard Law**/structure regulation"□revised				
1980	"**New Anti-seismic Design Code**" regulated			1978	Izuoh-shima Eq.*M* 7
1981	/seismic standards depend on "New Anti-seismic Design Code"	Ultimate lateral strength		1978	*Miyagiken-oki Eq.* M*7.4*
	/Consideration to the dynamic behaviour			1983	Nihonkaichuubu Eq.*M* 7.7
	/Two steps of design adopted			1993	Kushiro-oki Eq.*M* 7.8
	/Ultimate lateral strength, Structural characteristic coefficent etc., adop			1993	Hokaidonansei-oki Eq.. *M* 7.8
				1994	Sanrikuharuka-oki Eq. *M* 7.5
				1995	Hyougokennanbu Eq. *M* 7.2
1998	**Performance-ability oriented design** regulated				

After the enactment of the Standard Law on 1950, by each disastrous earthquake,

improvements have been made. After the 1964 Niigata earthquake, liquefaction regulation was introduced. In 1960s “High-rise Building Technical Guidelines” was published and construction of various and numerous tall buildings has started. After the 1969 Tokachi-oki earthquake, RC building regulation was changed etc. Since 1981, after the 1971 San Fernando and the 1978 Miyagi-ken-oki earthquakes, considering the former earthquake damage to RC buildings, two steps of design have been adopted, for example the primary design step for small or medium scale of earthquake motion which reformed on 1981, and the secondary step for large scale earthquake motion.

At the latest, the drastic revision was implemented and published on June 12, 1998, three years after the 1995 Kobe earthquake. The most significant revision in the regulation was that “specification” oriented design was moved to the introduction of “performance ability” oriented design.

The Performance-ability oriented design regulation is that of determining physical performance value with any kind of plan and structure, which satisfies the performance ability. This regulation can allow variety of design styles and thus it allows gentle progress in adopting various and new materials and technology.

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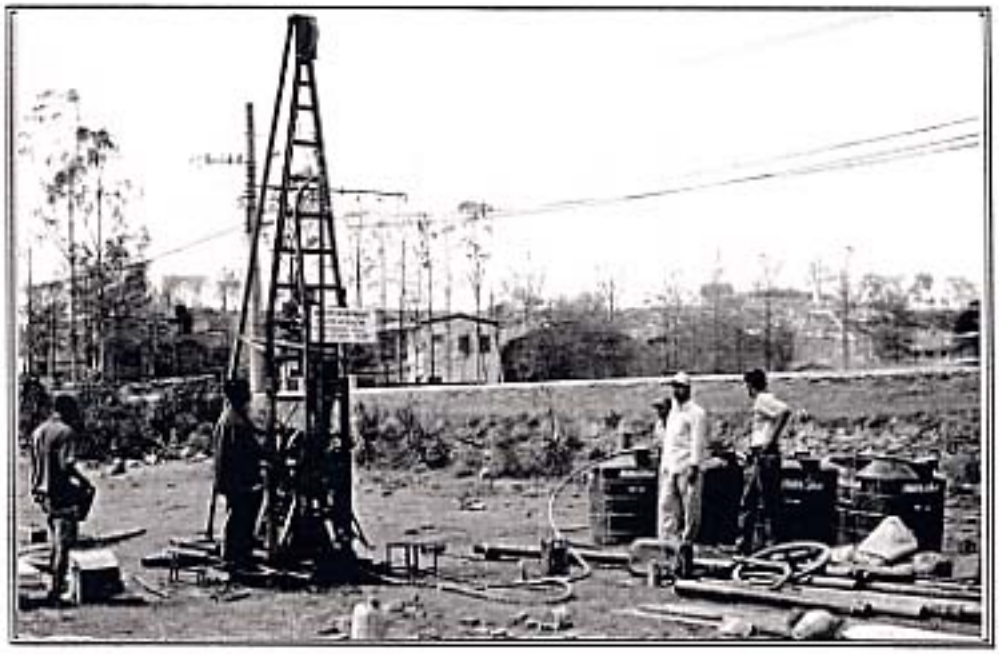
II Site Activity

II-1 Geological Investigation

THE STUDY
on
EARTHQUAKE DISASTER MITIGATION IN KATHMANDU VALLEY
KINGDOM OF NEPAL

GEOLOGICAL INVESTIGATION



FINAL REPORT

July, 2001

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FINAL REPORT

1. INTRODUCTION

Geological Investigation was carried out in four (4) locations in Kathmandu, Lalitpur, Madhyapur Thimi and Bhaktapur Municipalities within Kathmandu Valley. The Investigation included:

- Core drilling with Standard Penetration Test
- PS Logging in drill holes
- Laboratory tests.

Based on Terms of Reference for Geological Investigation, this Report contains item, quantity of investigation, methodology of investigation, outline of geology, summary of test results and geotechnical consideration.

2. PURPOSE OF THE INVESTIGATION

The main purpose of the Investigation was to obtain the geotechnical information about the subsurface conditions in Kathmandu Valley.

3. SCOPE OF THE WORK

The scope of the works include followings :

- Core drilling in soil, gravel, colluvial deposits at five (5) holes upto 30 m each. The diameter of borehole shall be 65 mm and effort should be made for 100% core recovery.
- Standard Penetration Test (SPT), in accordance with Japanese Standard shall be conducted at an interval of 1 m in five (5) drill holes.
- PS Logging shall be carried out in the five (5) drill holes at an interval of 2m; the interval may be changed as per Engineer's request.
- Laboratory tests shall be conducted for altogether 150 samples taken from all drill holes. The laboratory tests include :
  - Particle size Analysis of Sieve and hydrometer
  - Liquid Limit, Plastic Limit and Plasticity Index
  - Specific Gravity
  - Moisture Content
  - Unconfined Compression Strength

3.1 Quantity and Location

The quantity and location of drill holes are as below :

Hole No.	Depth (m)	Inclination (degree)	Location
BH-1	30	90	Courtyard of Fire Brigade, New Road, Kathmandu Municipality
BH-2	30	90	Northern Periphery Road, SinghaDurbar, Kathmandu Municipality
BH-3	30	90	In front of Sahaligram Apartment Hotel, Jawalakhel, Lalitpur Municipality
BH-4	30	90	Near Arniko Highway, Altech (P.) Ltd., Thimi, Madhyapur Municipality
BH-5	30	90	Durbar Square, Bhaktapur, Bhaktapur Municipality

The location maps of all boreholes are presented in Appendix - 1.

3.2 Period of the Work

The total work shall be completed by end of July 2001as specified in the ToR.

4. METHODOLOGY

4.1 Core Drilling

The core drilling was conducted using hydraulic driven rotatory type drilling machine with hole minimum diameter of 66 mm aiming 100 % core recovery. At the beginning, a hole of bigger diameter i.e. 110 mm was drilled and the diameter of drill hole was reduced to 90 mm and 75 mm depending upon site condition.

A core barrel of double tube type of 75 mm diameter was used to recover the core in the overburden top soil and then core barrel of 66 mm diameter used upto depth of 30 m. A continuous water was circulated during core drilling, however drilling without water circulation was done for good recovery of samples in case of un-cement deposits.

Core thus recovered were put in the core boxes for future references and laboratory tests. Casing pipes of HW (110 mm), NW (90 mm) and BW (75 mm) were used as per site condition throughout the drilling depth.

Standard Penetration Test

The Standard Penetration Test (SPT) was carried out in accordance with Japanese Standard. In each test, number of blows was recorded in the daily report of drilling for 50 cm- long section, divided into 5 parts, i.e. 5 cm of the first part, 10 cm of the second to fourth parts, and 15 cm of the fifth part. The test was abandoned if the cumulative number of blows reached to 60 times, even though total length of penetration was less than 50 cm. Soil samples thus retained in split tube during SPT were kept in plastic bags and put into core box at the corresponding depth.

Sampling

Undisturbed sampling was collected on silty or clayey strata using thin or Shelby Tube Sampler. After field verification and soil classification, the samples then collected were instantly sealed by paraffin wax in order to protect the loss of water content and these samples were also kept in the core boxes at the corresponding depth.

Borehole Logging

After field verification and classification of soils done based on Unified Soil Classification. Logging of the borehole was done in the standard format simultaneously during drilling. The borelogs are presented in Appendix 2.

Groundwater Level Measurement

Groundwater level at each borehole was carried out everyday before start and end of the drilling works. The site records of the groundwater level was recorded in the borelog.

4.2 PS Logging

Measurements of the P-waves and S-waves arrival time were carried out in the hole. The logging was carried out between depth 0-30 m at the interval of 2 m. S-waves were generated by hitting the opposite sides of a wooden log in horizontal direction. P-waves were generated by hitting in vertical direction on a wooden block. The Seismic sources for the P-and S-waves were established at about 3 m away from the drill holes. Measurements were carried out in steel cased drill holes. All the measurements were carried out by Seismograph McSeis 170 f, 24-channel, manufactured by OYO Corporation, Japan.

Data were recorded in a thermal paper for field inspection and in diskettes for the subsequent processing in the office.

P-waves and S-waves arrival times were picked up from the seismogram. The vertical travel time was calculated by using the formula.

$$T' = T \cos\theta$$

where, $\theta = \tan^{-1}(L/D)$

L- distance between drill hole and seismic source, m
D- depth to the probe from the surface , m
T- original travel time, ms
T'- adjusted travel time, ms

The details of field data are presented in the Appendix 3.

Travel times vs. depths were plotted in graphs and presented herewith in Fig. 1 to 5. Each linear segment in the graph indicates one velocity zone. Fittings of the line were carried out with reference to the N-values obtained in that section. Since the measured P-wave arrival were affected by steel casing, P-wave velocity were dropped out from calculation.

5. OUTLINE OF GEOLOGY

The Kathmandu valley is an intramontane basin located in the Lesser Himalayan region in Central Nepal. The bedrocks are exposed mainly along the surrounding hill slopes around the basin and a few in the valley floor. The bedrock exposed around the hill slope is meta-sedimentary as well as metamorphic. The rocks are classified into eight geological formations mainly Shivapuri Gneiss, Kulekahni Formation, Chandragiri Formation, Tistung Formation, Sopyang Formation, Markhu Formation, Chitlang Formation and Godavari Limestone of Katmandu Complex. The age of the rocks has been assigned from Pre-Cambrian to Devonian age. The valley is filled with the fluvio-lacustrine sediments of Quaternary age. The sediments are derived from the surrounding hills. The thickness of the valley sediments varies from place to place.

Boreholes Nos. B-1, B-4 and B-5 are situated in the Kalimati Formation that constitutes mainly gray to dark gray, silty clay and clayey silt. The constituting materials are calcareous nature at some places. Band of fine to coarse sand, peat and organic clay layers are common in the formation. The thickness of the formation is varies from place to place and it is up to 450.0 m.

Borehole No. B-2 lies at northern boundary of Singh Durbar situated in Gokarna Formation. It is slightly consolidated sediments that consist of light to brownish gray, fine laminated and poorly graded silty sand. Intercalations of clay of variable thickness are present on upper part. The thickness of such material is up to 300 m or more.

Borehole No. B-3 lies at Jawalakhel in Lalitpur district belongs to Quaternary deposit. The deposit consists of unconsolidated recent alluvial sediments of flood plane and lower alluvial terraces that constitutes clay, sand and fine gravel.

6. LABORATORY TEST

The samples collected during drilling were transported to the Laboratory for testing. The tests were conducted in accordance with ASTM or an equivalent standard.

6.1 Item, Method, Quality

The following number of tests were conducted based on ASTM and AASHTO methods:

S. No	Item	Standard Method	Quantity (Proposed)	Quantity (Conducted)
1.	Particle Size, Analysis by Sieve and Hydrometer	ASTM D421 & 422	30 Samples	112
2.	Liquid Limit, Plastic Limit and Plasticity Index	AASHTO T 89 & T 90	30 Samples	30
3.	Specific Gravity of Soil	AASHTO T100 or ASTM D854	30 Samples	51
4.	Moisture Content	ASTM D2216	30 Samples	18
5.	Unconfined Compression Strength	AASHTO T 89 & T 90	30 Samples	18

6.2 Summary of Test Results

Table 1 to 5 consists of summary of test results of samples collected from drill hole no. 1 to 5 respectively.

7. REPORTS

The following reports in accordance with ToR were submitted:

7.1 Daily Site Report

Daily report of drilling was submitted every day or next day to the Engineer. The daily report included the following informations :

- Drill hole number
- Date
- Work progress of the day
- Model, type, name of drilling machine
- Diameter of drill bit and casing
- Groundwater level in the drill hole
- Depth of drilling at each recovering of the core barrel
- Core recovery length at each core run
- Information about drilling water circulation
- Condition of the core sample
- Depth and rate of water loss or spring, if any
- Standard penetration test results
- Name of personnel in-charge of the drilling and testing.

7.2 Site Report

The Site Report was submitted after the completion of drilling works. The site report contains:

- drilling logs
- core photographs
- site records of SPT
- site records of PS Logging

7.3 Interim Report

The Interim Report was submitted after the completion of laboratory tests. The report included:

- summary sheets of the results
- photographs of samples
- data sheet and test plot of each test on approved form

7.4 Draft Report

The Draft Report was submitted after Interim Report. The report presents

- item, quantity of investigation
- methodology of investigation
- outline of geology
- summary of the results
- detailed results of each item
- geotechnical consideration for the Engineer's Comment.

7.5 Final Report

After revision, addition in the Draft Report after the comments, if any Final Report shall be submitted by the end of July 2001.

8. GEOTECHNICAL CONSIDERATION

BH # 1 at New Road, Kathmandu Metropolitancity

This borehole consists of stratified strata of sand and sandy silt with minimum SPT, N value observed 2 at 7.0 m depth. This layer of about 2 m thick strata is very loose and is considered to be geotechnically weak. Clayey silt medium stiff with little plasticity was encountered from 20 m to 30-m depth and the SPT, N values vary from 6 to 11.

BH # 2 at Singh Durbar, Kathmandu Metropolitancity

This borehole consists of sandy gravel and course to medium grained Sand, Silty Sand upto 21.0 m and then Clayey Silt follows up to 30.0 m with SPT, N value ranging 7 to 18. The borehole consists of good strata whose SPT, N values are greater than 12 upto 2 m from the existing ground. This area is considered to be geotechnically sound provided there will be no liquefaction during earthquake.

BH # 3 at Jawalakhel, Lalitpur Municipality

This borehole consists of Gravel and Gravely Sand in the shallow depth up to 4.0 m from the existing ground level. Then the strata consists of stratified layers of silty sand and clayey silt till throughout the depth upto 30 m. SPT, N values in this hole ranges from minimum 8 to maximum 60. This area is also considered to be geotechnically sound.

BH # 4 at New Thimi, Madhyapur Municipality

This borehole consists of mainly clayey silt comparatively thick soft layer than those encountered in other boreholes. The clayey silt strata starts from 8.0 m from the existing ground surface till the end of borehole at 30.0 m. The SPT, N values range from 6 to 10. Comparatively this area is considered to be geotechnically weak area.

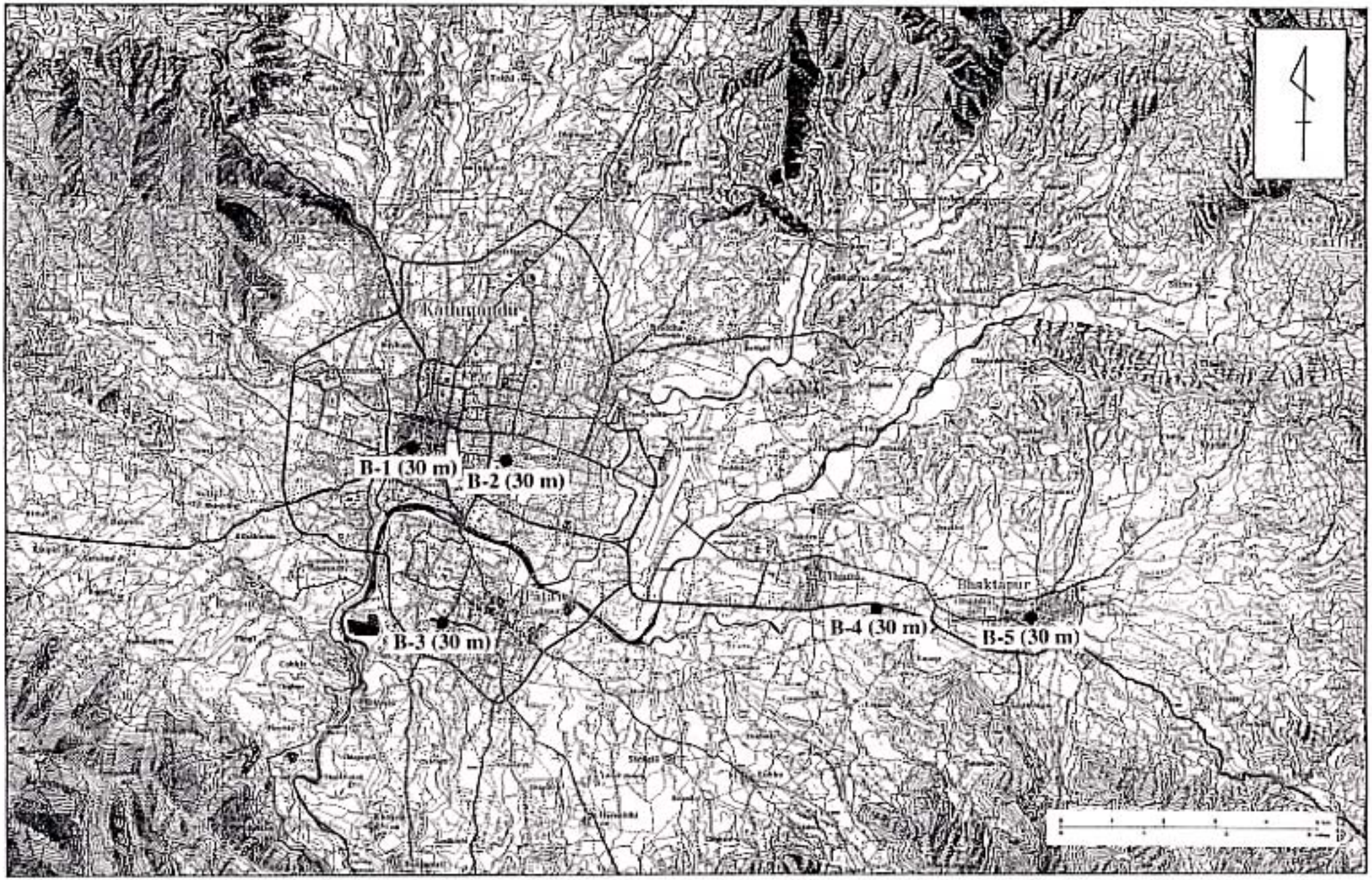
BH # 5 at Bhaktapur, Bhaktapur Municipality

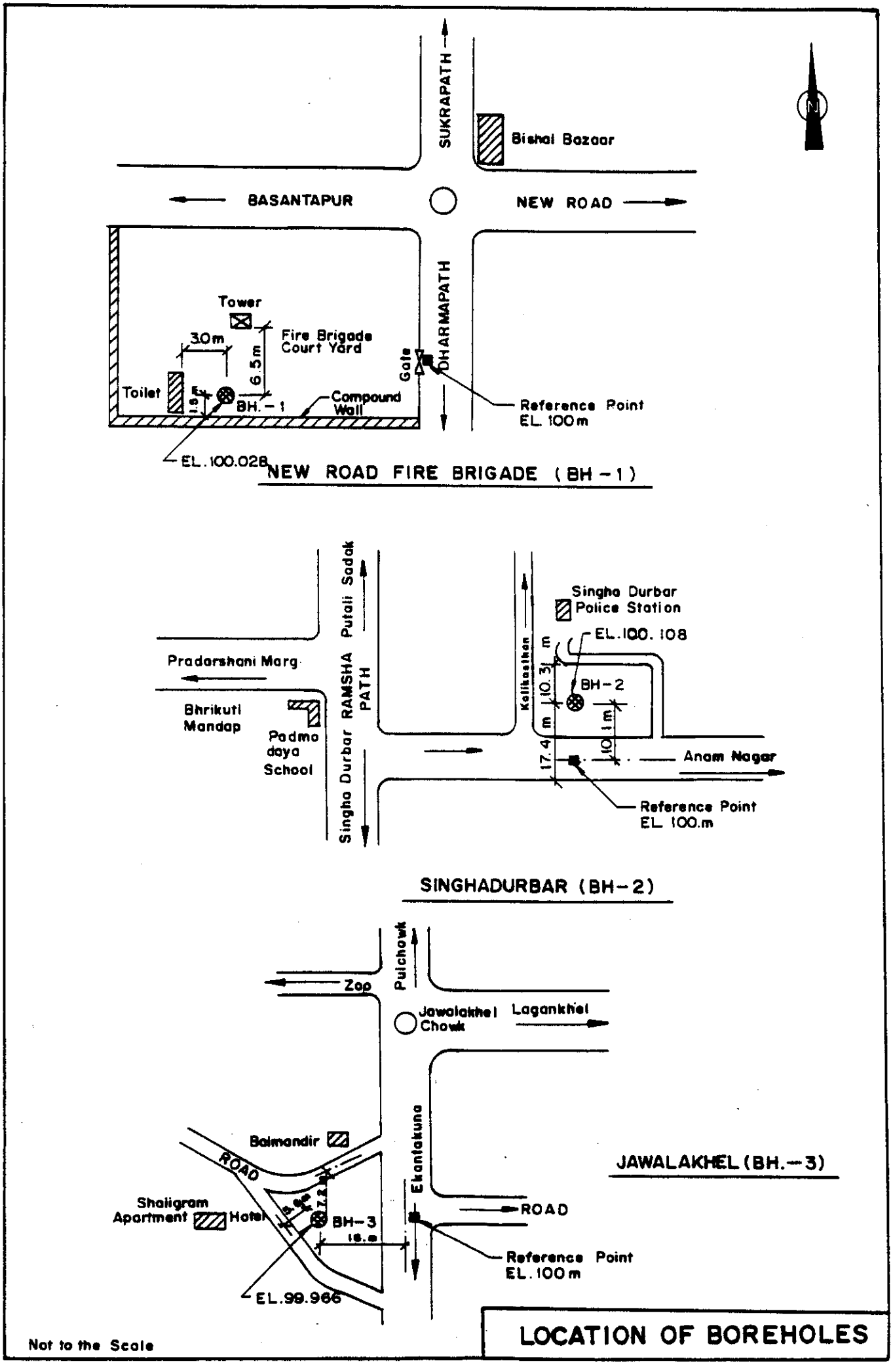
This borehole consists of mainly coarse to medium grained sand strata upto 19.0 m from the existing ground surface whose SPT, N values vary from 7 to 60. Then sandy silt/silty sand follows up to 22.0 m and clayey silt starts from 22.0 m till the end of borehole at 30.0 m with SPT, N values 7 to 18. This area is considered to be geotechnically medium good area.

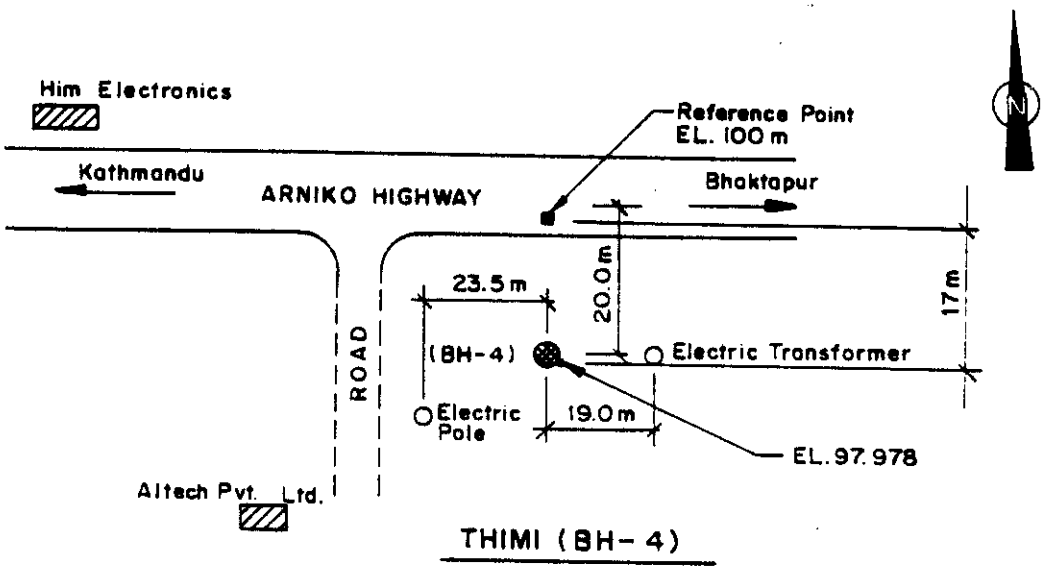
APPENDICES

APPENDIX - 1

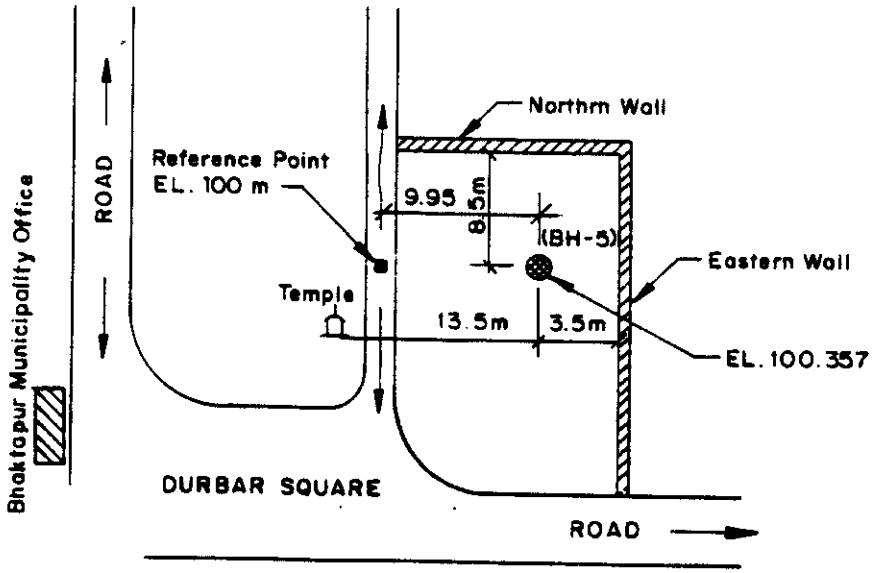
Location Maps of Borehole


Kathmandu
B-1 (30 m)
B-2 (30 m)
B-3 (30 m)
B-4 (30 m)
B-5 (30 m)
Bhaktapur


SUKRAPATH
Bishal Bazaar
BASANTAPUR
NEW ROAD
DHARMAPATH
Tower
3.0m
Fire Brigade Court Yard
6.5m
Toilet
1.5
BH. – 1
Compound Wall
Gate
Reference Point EL. 100m
EL. 100.028
NEW ROAD FIRE BRIGADE (BH – 1)
Putali Sadak
RAMSHA PATH
Singha Durbar
Police Station
EL. 100. 108
Kalikasthan
10.3 m
BH – 2
10.1m
17.4 m
Pradarshani Marg
Bhrikuti Mandap
Padmodaya School
Singha Durbar
Anam Nagar
Reference Point EL. 100.m
SINGHADURBAR (BH–2)
Pulchowk
Zoo
Jawalakhel Chowk
Lagankhel
Balmandir
ROAD
Ekantakuna
Shaligram Apartment
Hotel
BH–3
18.0
ROAD
Reference Point EL. 100m
EL. 99.966
JAWALAKHEL (BH.–3)
Not to the Scale
LOCATION OF BOREHOLES



THIMI (BH-4)



BHAKTAPUR DURBAR SQUARE (BH-5)

Not to the Scale

LOCATION OF BOREHOLES

APPENDIX - 2

Borelogs

GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 1
Sheet 1 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : New Road | Feature : Sunny

Type of Equipment & Methods : KOKEN, Hydraulic driven Rotatory type, Double Core Barrel

Diameter of Borehole: 66 mm | Inclination of Borehole: 90 degree

R.L. of Borehole : 100.028 m | Coordinates: | Reference Details: Courtyard of Fire Bigrade Office, Basantpur

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		water			meter									
0	HW		Top Overburden soil containing gravel, brick bats etc, loose		0.0		1							Returned
4/04	(110 mm)													
1			do		1.0	SPT-1	15	1	2	1	1	2	3	
			do and contains little mica		1.5		45							Returned
2	HW	dry												
4/05	(110 mm)	dry	Silty SAND, pinkish, medium grained, crushed brick bats, littlemicaceous		2.0	SPT-2	25	1	2	1	2	1	4	
			do		2.5		50							Returned
3			SAND, greyish, medium to coarse grained, mixed crushed little brick bats		3.0	SPT-3	45	1	4	6	8	12	20	
			do, but fine grained sand		3.5		50							Returned
4			SAND, whitish, coarse grained, mixed little crushed brickbats		4.0	SPT-4	40	2	4	10	12	14	30	
			SAND, whitish, medium to fine grained, with traces of Gravel, little micaceous		4.5		50							Returned
			Thin layer(10 cm) of greenish Silty Sand, little mica											
5			SAND, whitish, medium to fine grained, with crushed brick bats, little micaceous		5.0	SPT-5	45	2	7	13	11	17	35	
					5.5		50							Returned
6	HW		Silty SAND, dark grey, medium to fine grained, little micaceous		6.0									
	(110 mm)													

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001

Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 1
Sheet 2 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : New Road | Feature : Sunny

Type of Equipment & Methods : KOKEN, Hydraulic driven Rotatory type, Double Core Barrel

Diameter of Borehole: 66 mm | Inclination of Borehole: 90 degree

R.L. of Borehole : m | Coordinates: | Reference Details: Courtyard of Fire Bigrade Office, Basantpur

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		water			meter									
6	NW	0.35												
4/06	(90 mm)	0.50	Sandy SILT, dark grey, fine grained sand, little plasticity, soft, little micaceous		6.0	SPT-6	30	1	1	1	1	2	3	
			do		6.5		50							Returned
7			do, but very soft		7.0	SPT-7	40	1	2	0	1	1	2	
			do and soft		7.5		50							Returned
8			do		8.0	SPT-8	40	1	2	4	4	9	13	
					8.5		50							Returned
			Silty SAND, dark grey, fine grained sand, micaceous											
9			SAND, greyish, coarse to medium grained, medium dense,micaceous		9.0	SPT-9	40	1	6	5	8	9	18	
			do		9.5		50							Returned
10			SAND, mixed with greyish silty soil, coarse to medium grained, micaceous		10.0	SPT-10	50	1	2	3	4	10	12	
	NW	0.40												
4/07	(90 mm)	0.80	do, but fine grained sand		10.5		40							Returned
11			Silty SAND, greyish, madium to fine grained, medium dense, very micaceous		11.0	SPT-11	33	1	3	2	3	5	8	
			do		11.5		50							Returned
12	NW				12.0									
	(90 mm)													

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001

Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 1
Sheet 3 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : New Road | Feature : Sunny

Type of Equipment & Methods : KOKEN, Hydraulic driven Rotatory type, Double Core Barrel

Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details:

R.L. of Borehole : m | 90 degree | Courtyard of Fire Brigade Office, Basantpur

Drilling Process	Casing depth & dia	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
12	NW (90 mm)		Silty SAND/ Sandy SILT, greyish, medium to fine grained, medium dense, micaceous		12.0	SPT-12	45	1	1	2	5	8	15	
			do		12.5		50							Returned
	NW (90 mm)													
13	BW (75 mm)		Sandy SILT, greyish, fine grained sand, little or no plasticity, soft, micaceous		13.0	SPT-13	50	1	2	3	3	7	9	
			do		13.5		50							Returned
14			do		14.0	SPT-14	45	1	2	2	2	4	6	
			do		14.5		50							Dry Drilling
15			Silty SAND/ Sandy SILT, greyish, medium to fine grained, loose, micaceous		15.0	SPT-15	48	1	1	1	1	3	3	
			Sandy SILT, greyish, fine grained sand, little plasticity, micaceous		15.5	UD - 1	45							Dry Drilling
16			Sandy SILT, greyish, fine grained sand, little or no plasticity, soft, micaceous		16.0	SPT-16	47	1	2	1	1	2	3	
			do		16.5		50							Dry Drilling
17			Sandy SILT, dark grey, fine grained sand, little or no plasticity, soft, micaceous		17.0	SPT-17	46	1	2	2	1	3	5	
			do		17.5		50							Dry Drilling
18	BW (75 mm)				18.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001 | Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 1
Sheet 4 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : New Road | Feature : Sunny

Type of Equipment & Methods : KOKEN, Hydraulic driven Rotatory type, Double Core Barrel

Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details:

R.L. of Borehole : m | 90 degree | Courtyard of Fire Brigade Office, Basantpur

Drilling Process	Casing depth & dia	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
18	BW (75 mm)		Sandy SILT, greyish, fine grained sand, little or no plasticity, soft, micaceous		18.0	SPT-18	48	1	1	2	3	4	8	
	4/08	4.20			18.5		50							Dry Drilling
		4.80	do											
19			Silty SAND greyish, fine grained sand, little or no plastic fines, loose, micaceous		19.0	SPT-19	36	1	1	2	2	4	7	
			Clayey SILT, medium grey, little fine grained sand, pitch black, moderately plastic soil, little micaceous		19.5	UD - 2	45							Dry Drilling
20			do		20.0	SPT-20	50	1	1	2	3	6	9	
			do		20.5		50							Dry Drilling
21			do		21.0	SPT-21	50	1	1	2	2	4	7	
			do		21.5		45							Dry Drilling
22			do		22.0	SPT-22	48	1	2	2	3	5	9	
			do		22.5		50							Dry Drilling
23			do		23.0	SPT-23	48	1	2	2	3	4	8	
			do		23.5		50							Dry Drilling
24	BW (75 mm)				24.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001 | Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 1
Sheet 5 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : New Road | Feature : Sunny
Type of Equipment & Methods : KOKEN, Hydraulic driven Rotatory type, Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details: Courtyard of Fire Brigade Office, Basantpur
R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter								
24	BW (75 mm)		Clayey SILT, dark grey, little fine grained sand, moderately plasticity, stiff		24.0	SPT-24	47	1	1	2	2	3	5 Dry Drilling
			do		24.5	UD- 3	45						
25			do		25.0	SPT-25	50	2	3	3	4	5	11
			do		25.5		50						
26			do		26.0	SPT-26	46	1	1	2	3	5	8
			do		26.5		45						
27			do		27.0	SPT-27	47	1	2	2	3	6	11
			do		27.5		50						
28			do		28.0	SPT-28	50	1	2	2	3	4	8
			do		28.5		50						
29			do		29.0	SPT-29	50	1	2	3	3	4	9
			do		29.5	UD - 4	50						
4/08	BW (75 mm)	8.10											
30		8.50	End of Borehole		30.0	SPT-30	50	1	2	2	1	3	5 Dry Drilling

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : April 4, 2001 | Date Completed: April 8, 2001

Logged By

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 2
Sheet 1 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Singh Durbar | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details: near Singh Durbar Police Office, Northen Periphery Road of Singh Durbar
R.L. of Borehole : 100.105 m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter								
0 3/28	HW (110 mm)		Top Overburden soil containing gravel, brick bats, old concrete block etc		0.0								
					1.5								Lost
1					1.0	SPT-1	7		1		2	3	4
					2.5		30						Lost
			Silty SAND, yellowish/greyish, micaceous, loose										
2			Sandy GRAVEL, yellowish, mixed with little greyish silty soil, loose		2.0	SPT-2	20		3		4	4	8
			Sandy SILT, dark grey, little plasticity, with little Gravel		2.5		55						Lost
3			SAND, light grey, fine grained, micaceous, loose upto 3.35 m and a thin layer of medium grey little plastic Clayey SILT,from 3.35 to 3.45 m		3.0	SPT-3	45		1		4	5	9
			Sandy SILT, greyish/yellowish, little plastic, with little Gravel, micaceous		3.5		55						Returned
4			SAND, whitish, medium to coarse grained, with little greyish silty soil, little micaceous, medium dense		4.0	SPT-4	17		6		7	16	31
			SAND, whitish, coarse grained, with little Gravel little micaceous, medium dense		4.5		0						Lost
5			do		5.0	SPT-5	30		9		18	19	36
		dry											
3/27		dry			5.5		30						Loss
6	HW 110 mm				6.0								

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : March 26, 2001 | Date Completed: April 2, 2001

Logged By

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 2
Sheet 2 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Singh Durbar | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: near Singh Durbar Police Office, Northen Periphery Road of Singh Durbar
R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Legen & Thickness	Sample Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
6	HW 110 mm		SAND, whitish, coarse grained,with little Gravel little micaceous, medium dense		6.0	SPT-6	28		10		20	25	42	
	NW 90 mm		SAND, whitish/yellowish, medium grained, with little Gravel little micaceous, very dense		6.5									Lost
7		6.4			7.0	SPT-7	20		18	>42 / 28 cm			>68	
3/28		7.0	SAND, whitish/yellowish, medium grained, with very micaceous, medium dense, little greyish plastic soil encountered at 7.5 m		7.5		50							Less Returned
8			SAND, whitish/yellowish, coarse grained, with little Gravel, very micaceous, medium dense		8.0	SPT-8	30		7	7	8	11	23	
					8.5		50							Returned
			Silty SAND, dark grey, fine grained sand, very micaceous											
9			SAND, greyish, fine to medium grained, very micaceous, medium dense		9.0	SPT-9	42		3	3	7	14	27	
					9.5		50							Returned
10		5.85												
3/29		6.4			10.0	SPT-10	50	3	4	6	5	12	18	
					10.5		50							Returned
			Sandy SILT, dark grey, little plastic (lense or thin layer)											
11			SAND, coarse grained, micaceous, dense		11.0	SPT-11	45	3	5	9	10	14	28	
		6.0												
3/30		6.0	SAND, fine to medium grained, micaceous, dense		11.5		50							Returned
12	NW 90 mm				12.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : March 26, 2001
Date Completed: April 2, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 2
Sheet 3 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Singh Durbar | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: near Singh Durbar Police Office, Northen Periphery Road of Singh Durbar
R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Legen & Thickness	Sample Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N values	Water Recovery
		meter			meter									
12	NW 90 mm		SAND, whitish, coarse grained, a fraction of brick bat, medium dense		12.0	SPT-12	46	5	20	14	10	15	32	
			SAND, greyish/yellowish, medium grained, medium dense		12.5		50							Lost
13			SAND, whitish, medium to coarse grained, little mica, medium dense		13.0	SPT-13	38	3	6	5	6	12	29	
			SAND, whitish/yellowish, medium grained,with little Gravel little micaceous, medium dense		13.5		50							Returned
14			SAND, whitish/yellowish, medium to coarse grained little micaceous, medium dense		14.0	SPT-14	47	3	7	8	7	12	23	
		6.2												Returned
3/31		8.7			14.5		50							
15			SAND, coarse grained, greyish, mixed with little dark grey silty soil, micaceous, dense		15.0	SPT-15	48	4	6	10	10	17	32	
			SAND, greyish, medium grained, micaceous		15.5		50							Returned
16			do as above, medium dense		16.0	SPT-16	50	6	11	9	9	15	29	
			SAND, greyish, fine grained, very micaceous		16.5		50							Returned
17			SAND, dark grey, fine grained, very micaceous, medium dense		17.0	SPT-17	30	5	8	11	10	16	32	
			SAND, medium grey, fine grained, very micaceous		17.5		50							Returned
18	NW 90 mm				18.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : March 26, 2001
Date Completed: April 2, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO :: BH - 2
Sheet 4 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Singh Durbar | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree
R.L. of Borehole : m | Coordinates: | Reference Details: near Singh Durbar Police Office, Northen Periphery Road of Singh Durbar

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
18	NW 90 mm		SAND, dark grey, fine to medium grained, micaceous, dense		18.0	SPT-18	40	3	6	8	11	13	27	Black colour Returned
			SAND, greyish, fine grained, micaceous		18.5		50							
19			Silty SAND, pitch black, medium grained sand, little plastic soil, little micaceous; organic odour, medium dense		19.0	SPT-19	30	3	7	9	8	12	24	
			SAND, greyish, fine grained, little mica		19.5		50							Returned
20		6	Silty SAND, dark grey, medium grained sand, little micaceous											
4/01		6.3	Silty SAND/Sandy SILT, pitch black, medium grained sand,moderately plastic soil, little micaceous,organic odour, medium dense		20.0	SPT-20	50	2	3	3	4	6	12	
21					20.5		50							Returned
					21.0	SPT-21	45	1	3	3	3	5	9	
			Clayey SILT, pitch black, little fine to midium grained sand, moderate plasticity, stiff		21.5	UD - 1	45							Dry Drilling
	NW 90 mm													
22	BW 75 mm		Clayey SILT, pitch black, little fine grained sand, moderately plasticity, stiff		22.0	SPT-22	45	2	2	3	3	4	8	
			do		22.5		50							Dry Drilling
23			do		23.0	SPT-23	46	1	2	3	3	5	9	
			do		23.5		50							Dry Drilling
24	BW 75 mm				24.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : March 26, 2001
Date Completed: April 2, 2001

Logged By

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 2
Sheet 5 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Singh Durbar | Feature : Sunny / Cloudy
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree
R.L. of Borehole : m | Coordinates: | Reference Details: near Singh Durbar Police Office, Northen Periphery Road of Singh Durbar

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
24	BW 75 mm		Clayey SILT, pitch black, little fine grained sand, moderately plasticity, stiff		24.0	SPT-24	46	1	2	2	3	4	8	Dry Drilling
			do		24.5		50							
25			do		25.0	SPT-25	47	2	3	3	4	5	15	
			do		25.5		50							
26			do		26.0	SPT-26	46	1	2	2	3	4	9	
			do		26.5	UD-2	46							
27			do		27.0	SPT-27	45	2	3	3	4	5	10	
		7.0	do		27.5		50							
4/02		7.75	do		28.0	SPT-28	45	2	3	2	2	4	7	
28			do		28.5		50							
			do		29.0	SPT-29	46	4	5	5	6	9	16	
29			do		29.5		50							
	BW 75 mm	17.0												
30		17.5	End of Borehole		30.0	SPT-30	45	5	6	6	5	9	17	Dry Drilling

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : March 26, 2001
Date Completed: April 2, 2001

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 3
Sheet 1 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Jawalakhel | Feature : Sunny
Type of Equipment & Methods : KOREN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: infront of Shatigram
R.L. of Borehole : 99.966 m | Apartment Hotel at Jawalakhel, Lalitpur

Process Data	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
0	HW		Top Overburden soil containing Silt, Sand and brick bats, old concrete piece etc		0.0									
4/23	(110 mm)						1							Re-turned
			do											
1			do		1.0	SPT-1	25	2	5	3	4	6	12	
					1.5		50							Re-turned
			Silty SAND, greyish/reddish, with crushed brick and little brick bats											
2			Gravelly SAND, greyish/reddish, coarse grained, with little brick bats and encountered boulder at 2.5 m		2.0	SPT-2	50	1	2	5	7	13	23	
					2.5		50							Re-turned
			do with max size of boulder10 cm in length											
3			Sandy GRAVEL, greyish, with boulder of max size 20 cm in length		3.0	SPT-3	20	5	17	10	18	-	> 80	
			do with boulder of max size 7 cm in length		3.5		50							Ret-urned
4	HW (110 mm)	2.3												
4/24	NW (90 mm)	2.6	SAND, yellowish/brownish, coarse to medium grained, highly compacted, dense, very little mica content		4.0	SPT-4	25	3	5	8	10	15	38	
			Silty SAND, greyish, medium to fine grained sand, very little mica content, little gravel (2.5 cm) encountered at 4.6 m		4.5		50							Re-turned
5			Silty SAND, greyish, medium to fine grained sand, medium dense, very little mica content, little gravel (5.0 cm)		5.0	SPT-5	25	5	7	5	4	7	14	
					5.5		50							Lost
			do											
6	HW (110 mm)				6.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 23, 2001
Date Completed: April 26, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 3
Sheet 2 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Jawalakhel | Feature : Sunny
Type of Equipment & Methods : KOREN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: infront of Shatigram
R.L. of Borehole : m | Apartment Hotel at Jawalakhel, Lalitpur

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
8	HW		Mixure of greyish Silty SAND-GRAVEL (4cm) and crushed brick, medium dense		6.0	SPT-6	45	2	5	8	5	9	17	
	(110 mm)													Lost
	NW		do with boulder (8 cm) encountered at 6.55 m		6.5		50							
7	(90 mm)		Silty SAND, greyish, medium to fine grained Sand, traces of Gravel, medium dense, very high water content		7.0	SPT-7	50	1	3	5	5	9	18	
			do		7.5		50							Ret-urned
8			Silty SAND, greyish, medium to fine grained Sand, medium dense		8.0	SPT-8	48	2	2	4	4	8	15	
			do		8.5		50							Ret-urned
9			Silty SAND, greyish, fine grained Sand, loose		9.0	SPT-9	40	1	2	2	4	4	8	
			do		9.5		45							Ret-urned
10			Silty SAND, greyish, medium to fine grained Sand, medium dense		10.0	SPT-10	46	2	2	3	4	10	11	
			do and with Gravel (4cm) encountered at 10.8 m		10.5		50							Ret-urned
11			SAND, greyish, medium to fine grained Sand, with little Silt, highly comapcted, medium dense		11.0	SPT-11	50	2	6	8	11	15	39	
			do		11.5		50							Ret-urned
12	NW (90 mm)				12.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 23, 2001
Date Completed: April 26, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 3
Sheet 3 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Jawalakhel | Feature : Sunny

Type of Equipment & Methods : KOREN, Rotatory Double Core Barrel

Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: Infront of Shaligram Apartment Hotel at Jawalakhel, Lalitpur

R.L. of Borehole : m | 90 degree

Depth	Casing Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
			meter			meter									
12	NW	(90 mm)		Silty SAND, greyish, medium to fine grained Sand, medium danse		12.0	SPT-12	46	1	2	3	6	8	17	
				do		12.5		50							Returned
13				Silty SAND, greyish/whitish, fine grained Sand, loose		13.0	SPT-13	46	1	2	2	3	5	10	
	4/25		2.9 / 2.5	do		13.5		45							Returned
14				Silty SAND, dark grey, medium to fine grained Sand, medium dense		14.0	SPT-14	50	2	3	5	5	9	18	
				do		14.5	UD - 1	45							Returned
15				Sandy SILT, dark grey, with little fine grained sand, little or no plasticity, stiff		15.0	SPT-15	50	2	3	5	6	8	17	
				do		15.5		50							Returned
16				Silty SAND/Sandy SILT, dark grey, fine grained Sand, medium dense		16.0	SPT-16	50	1	2	3	4	7	12	
				do		16.5		50							Returned
17				Clayey SILT, dark grey, with little fine grained sand, little or no plasticity, stiff		17.0	SPT-17	46	1	2	2	3	4	8	
				do		17.5		50							Dry Drilling
18	NW	(90mm)				18.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : April 23, 2001 | Date Completed: April 26, 2001

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Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 3
Sheet 4 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Jawalakhel | Feature : Sunny

Type of Equipment & Methods : KOREN, Rotatory Double Core Barrel

Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: Infront of Shaligram Apartment Hotel at Jawalakhel, Lalitpur

R.L. of Borehole : m | 90 degree

Depth	Casing Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
			meter			meter									
18	NW	(90 mm)		Silty SAND/Sandy SILT, dark grey, fine grained Sand, loose		18.0	SPT-18	46	1	2	3	3	5	9	
				do		18.5		50							Returned
19				Silty SAND, dark grey, fine grained Sand, medium dense		19.0	SPT-19	45	2	5	7	8	3	28	
		NW (90 mm) / BW (75 mm)		Sandy SILT / Silty SAND, dark grey, little or no plasticity, little fine grained sand with very little mica		19.5	UD - 2	45							Returned
20				do		20.0	SPT-20	46	1	2	3	3	5	10	
				do		20.5		50							Dry Drilling
21				Clayey SILT, dark grey, little fine grained Sand, little or no plasticity, stiff		21.0	SPT-21	45	1	2	3	4	5	10	
				do		21.5		50							Dry Drilling
22				do but high water content		22.0	SPT-22	50	2	3	4	3	9	10	
				do		22.5		50							Dry Drilling
23				Sandy SILT / Silty SAND, dark grey, little or no plasticity, little fine grained sand with very little mica		23.0	SPT-23	50	2	5	5	6	8	17	
				do		23.5		50							Dry Drilling
24	BW	(75 mm)				24.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Date Started : April 23, 2001 | Date Completed: April 26, 2001

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 3
Sheet 5 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Jawalakhel | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details: infront of Shalgram
R.L. of Borehole : m | 90 degree | Apartment Hotel at Jawalakhel, Lalitpur

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
24	BW (75 mm)		Sandy SILT / Silty SAND, dark grey, little or no plasticity, little fine grained sand with very little mica		24.0	SPT-24	45	2	3	3	4	7	11	Dry Drilling
			do		24.5	UD - 3	45							
25			Clayey SILT, dark grey, little fine grained Sand, little or no plasticity, stiff		25.0	SPT-25	48	2	3	5	6	8	16	
4/26		3.1			25.5		50							Re-turned
		3.7	do											
26			Sandy SILT / Silty SAND, dark grey, little or no plasticity, little fine grained sand with very little mica		26.0	SPT-26	50	2	4	5	5	9	17	
			do		26.5		50							Re-turned
27			Clayey SILT, dark grey, little fine grained Sand, little or no plasticity, stiff		27.0	SPT-27	47	2	3	4	5	9	17	
			do		27.5		50							
28			Sandy SILT / Silty SAND, dark grey, little or no plasticity, little fine grained sand with very little mica		28.0	SPT-28	50	2	4	5	6	10	21	
			do		28.5		50							
29			Clayey SILT, dark grey, little fine grained Sand, little or no plasticity, stiff		29.0	SPT-29	48	2	3	4	6	9	19	
			do		29.5	UD - 4	40							
4/20	BW (75 mm)	3.70												Dry Drilling
30			End of Borehole		30.0	SPT-30	40	4	4	4	5	12	14	

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 23, 2001 | Date Completed: April 26, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 4
Sheet 1 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Thimi | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: | Coordinates: | Reference Details:
R.L. of Borehole : 97.978 m | 90 degree | at RoW of Araniko Highway, near Attech (P) Ltd.

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
0	HW		Top Overburden soil containing silt. Sand and grass roots etc		0.0									
04/10	(110 mm)						1							Re-turned
			SiltySAND, yellowish/whitish, coarse grained with little gravel, very little mica content											
1					1.0	SPT-1	20	1	1	1	1	2	3	
			do											
					1.5		50							Re-turned
			do											
2					2.0	SPT-2	27	1	2	2	2	3	6	
			Silty SAND, brownish, coarse grained with little gravel,very little mica content											
					2.5		50							Re-turned
			do											
3					3.0	SPT-3	20	2	2	3	2	4	7	
			do with a thin lens of greyish clayey silt at the end of the tube											
					3.5		50							Ret-turned
			Silty SAND, whitish, coarse to medium grained, very little mica content											
			A thin layer of greyish silty GRAVEL											
4					4.0	SPT-4	35	1	3	2	2	4	7	
			Clayey SILT, dark grey, with little fine grained sand, little micaceous											
					4.5		50							Re-turned
			SAND, whitish, medium to fine grained, with tracesof Gravel, little micaceous											
5	HW 110 mm		Thin layer(10 cm) of greenish Silty Sand, little mica											
04/11	HW 90 mm	3.0	Silty SAND, whitish, coarse to medium grained, littlemicaceous		5.0	SPT-5	40	2	1	1	3	4	8	
					5.5		50							Re-turned
			do											
6	HW (110 mm)				6.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001 | Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 4
Sheet 2 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Thimi | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: at RoW of Amlko Highway, near Alitech (P) Ltd.
R.L. of Borehole : m

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
6	NW (90 mm)		Silty SAND, whitish, coarse to medium grained, littlemicaceous		6.0	SPT-6	40	2	3	3	4	5	11	
			do		6.5		50							Returned
7			do		7.0	SPT-7	45	1	2	2	1	4	6	
			Sandy SILT, greyish, fine grained sand, micaceous		7.5		50							Returned
			do											
8			Calyey SILT, medium grey, little fine grained sand, micaceous, little or no plasticity, stiff		8.0	SPT-8	45	1	1	2	3	5	9	
			do		8.5		50							Returned
9			do		9.0	SPT-9	45	1	2	2	3	4	8	
			do		9.5		50							Returned
10	NW (90 mm)	4.50												
04/12		6.00	do		10.0	SPT-10	40	1	1	2	3	4	8	
	NW (90 mm)		do		10.5	UD - 1	40							Returned
11			Calyey SILT, medium grey, little fine grained sand, micaceous, moderate plasticity, stiff		11.0	SPT-11	40	1	2	2	3	5	9	
			do		11.5		50							Returned
12	NW (90 mm)				12.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001
Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 4
Sheet 3 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Thimi | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: at RoW of Amlko Highway, near Alitech (P) Ltd.
R.L. of Borehole : m

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
12	NW (90 mm)		Calyey SILT, medium grey, little fine grained sand, micaceous, moderate plasticity, stiff		12.0	SPT-12	45	2	3	3	4	5	10	
			do		12.5		50							Returned
13			do		13.0	SPT-13	46	1	1	2	3	4	8	
			do		13.5		50							Returned
14			Calyey SILT, medium grey, little fine grained sand, micaceous, moderate plasticity, compacted and stiff		14.0	SPT-14	45	1	1	2	2	4	7	
			do		14.5	UD - 2	50							Dry Drilling
15			do		15.0	SPT-15	46	1	1	2	2	3	6	
			do		15.5		45							Dry Drilling
16			do		16.0	SPT-16	45	1	1	3	2	4	7	
			do		16.5		50							Dry Drilling
17			do		17.0	SPT-17	46	1	1	2	2	3	8	
			do		17.5		50							Dry Drilling
18	NW (90 mm)				18.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001
Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 4
Sheet 4 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Thimi | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: at RoW of Arniko Highway, near Attach (P) Ltd.
R.L. of Borehole : m

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Legend & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
18	NW (90 mm)		Clayey SILT, medium grey, little fine grained sand, micaceous, moderate plasticity, compacted and stiff		18.0	SPT-18	47	1	2	2	2	3	6	
			do		18.5		50							Dry Drilling
19			do		19.0	SPT-19	45	1	2	1	2	4	7	
			do		19.5	UD - 3	45							Dry Drilling
20	NW (90 mm)	5.5												
04/13	BW (75 mm)	8.2	do		20.0	SPT-20	45	1	2	3	3	5	18	
			do		20.5		50							Dry Drilling
21			do		21.0	SPT-21	46	1	2	2	3	4	9	
			do		21.5		45							Dry Drilling
22			do		22.0	SPT-22	46	1	1	2	2	5	8	
			do		22.5	UD - 4	40							Dry Drilling
23			do		23.0	SPT-23	45	1	2	2	1	3	5	
			do		23.5		50							Dry Drilling
24	BW (75 mm)				24.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001
Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 4
Sheet 5 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Thimi | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 86 mm | Inclination of Borehole: 90 degree | Coordinates: | Reference Details: at RoW of Arniko Highway, near Attach (P) Ltd.
R.L. of Borehole : m

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Legend & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
24	BW (75 mm)		Clayey SILT, medium grey, little fine grained sand, micaceous, moderate plasticity, compacted and stiff		24.0	SPT-24	46	1	1	2	3	4	8	Dry Drilling
			do		24.5		45							
25			do		25.0	SPT-25	45	1	2	2	2	4	7	
			do		25.5		50							
26			do		26.0	SPT-26	41	1	1	2	3	3	8	
			do		26.5		45							
27			do		27.0	SPT-27	45	1	2	1	2	3	8	
			Clayey SILT, dark grey, little fine grained sand, micaceous, moderate plasticity, compacted and stiff		27.5	UD - 5	40							
28			do		28.0	SPT-28	46	1	2	2	3	4	8	
			do		28.5		50							
29			do		29.0	SPT-29	45	1	2	2	3	4	8	
			do		29.5	UD - 6	40							
4/08	BW (75 mm)	4.00												Dry Drilling
30		4.80	End of Borehole		30.0	SPT-30	45	1	1	2	3	4	8	

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 4, 2001
Date Completed: April 8, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 5
Sheet 1 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Bhaktapur | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: 90 degree
R.L. of Borehole : 100.357 m | Coordinates: | Reference Details: at Durbar Square in front of Bhaktapur Municipality

Process Date	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
0	HW (110 mm)		Top Overburden soil containing Silt, Sand and brick bats, old concrete piece etc		0.0									
4/16			do				1							Returned
1			do upto 1.6 m		1.0	SPT-1	20	3	5	6	6	8	18	
	HW (110 mm)	0			1.5		50							Returned
4/17	HW (110 mm)	0	Clayey SILT/Silty CLAY, greyish/yellowish, modderate plasticity											
2			Clayey SILT, greyish/yellowish,little or no plasticity up to 2.6 m		2.0	SPT-2	50	4	3	3	4	5	11	
			Sandy SILT, greyish, with crushed brick bats		2.5		50							Returned
3			Stratified soil layer consists of whitish Clayey Silt with crushed brick bats from 3.0 to 3.2 m, dark grey Clayey Silt with high plasticity from 3.2 to 3.4 m and greyish Clayey Silt with low plasticity from 3.4 to 3.5 m		3.0	SPT-3	40	1	1	2	4	5	13	
			Silty SAND/Sandy SILT, greyish, medium to fine grained, little mica content		3.5		50							Returned
4			do		4.0	SPT-4	20	2	4	5	6	10	19	
			Clayey SILT, pitch black, little fine micaceous sand, medium plasticity, organic odour		4.5		50							Returned
5			Mixture of medium grained Sand, old brick bats, pitch black Clayey Silt etc. up to 5.25 m		5.0	SPT-5	50	1	1	1	2	5	8	
			Clayey SILT, medium grey, moderately plasticity, traces of fine grained micaceous Sand		5.5		50							Returned
			do											
6	HW (110 mm)				6.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 16, 2001 | Date Completed: April 20, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 5
Sheet 2 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Bhaktapur | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: 90 degree
R.L. of Borehole : m | Coordinates: | Reference Details: at Durbar Square in front of Bhaktapur Municipality

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
6	HW (110 mm)		Silty SAND, greyish, medium to fine grained Sand, little micaceous, high moisture content		6.0	SPT-6	45	1	1	1	2	3	7	
	NW (90 mm)		do		6.5		50							Returned
7			Silty SAND, greyish, medium to fine grainedSand, little micaceous, traces of Gravel and occasional Brick bats		7.0	SPT-7	50	1	2	2	4	4	9	
			Sandy SILT, greyish, fine grained micaceous Sand		7.5		50							Returned
8			Silty SAND, medium grey, silte fine grained sand, micaceous, little or no plasticity, stiff		8.0	SPT-8	48	2	4	6	10	12	24	
	NW (90 mm)	4.0												Returned
4/18	NW (90 mm)	4.2	Silty SAND, greyish, medium to fine grainedSand, little micaceous, mixed with whitish soil lump, few red iron stain seen		8.5		30							
9			Silty SAND, greyish, medium to fine grained Sand, little micaceous,		9.0	SPT-9	50	2	4	4	5	9	18	
			do and few grass roots seen		9.5		48							Returned
10			Silty SAND, greyish/yellowish, medium to fine grained Sand, highly micaceous,		10.0	SPT-10	47	2	4	4	6	10	20	
			do with some grass roots		10.5		50							Returned
11			Mixture of coarse to medium grained Sand, pinkish coloured Sand, dark grey/ greyish Silty soil, few red iron stain (seems like fill material)		11.0	SPT-11	40	2	7	7	12	14	28	
			Silty Sand, pitch black, medium to fine grained highly micaceous sand,		11.5		50							Returned
12	NW (90 mm)				12.0									

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 16, 2001 | Date Completed: April 20, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 5
Sheet 3 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Bhaktapur | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: at Durbar Square in front of Bhaktapur Municipality
R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
12	NW (90 mm)		Silty SAND, pitch black, coarse grained micaceous sand,		12.0	SPT-12	48	2	4	4	6	8	16	
			SAND, whitish, medium to fine grained, micaceous		12.5		50							Returned
13			SAND, greyish, medium to fine grained, little micaceous, high moisture content		13.0	SPT-13	40	2	2	3	5	8	13	
			do but whitish colour dominates		13.5		50							Returned
14			SAND, whitish, coarse grained, little micaceous		14.0	SPT-14	42	6	8	12	12	12	32	
			do but grain size changes to medium to fine		14.5		50							Returned
15			Mixture of coarse grained SAND and whitish Clayey/Silty soil		15.0	SPT-15	20	5	6	8	11	12	27	
	NW (90 mm)	8.0												
4/19	NW (90 mm)	8.6	SAND, greyish/whitish, coarse to medium grained, little micaceous,		15.5		50							Returned
16			do but high moisture content		16.0	SPT-16	35	3	5	18	24	-	> 66	
			do		16.5		50							Returned
17			do		17.0	SPT-17	30	4	7	12	16	11	37	
	NW (90 mm)													
	BW (75 mm)		do		17.5		50							Dry Drilling
18	BW (75 mm)				18.0									

Legend:
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 16, 2001 | Date Completed: April 20, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 5
Sheet 4 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Bhaktapur | Feature : Sunny
Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel
Diameter of Borehole: 66 mm | Inclination of Borehole: | Coordinates: | Reference Details: at Durbar Square in front of Bhaktapur Municipality
R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Depth & Thickness	Sample/Test Type	Rec. (cm)	Field Records: SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
18	BW (75 mm)		SAND, greyish/whitish, medium to fine grained, little micaceous		18.0	SPT-18	30	2	6	10	13	19	37	
			do with some grass roots		18.5		50							Returned
19			do up to 19.3 m		19.0	SPT-19	45	3	4	6	5	6	15	
			Silty SAND, greyish, medium to fine grained sand, micaceous, some grass roots upto 19.5 m		19.5		50							Returned
20			Clayey SILT / Silty Clay, greyish, moderate to high plasticity, little or traces of fine sand with little mica		20.0	SPT-20	30	2	3	4	6	9	17	
			Sandy SILT / Silty Sand, greyish, little or no plasticity, little fine grained sand with little mica		20.5		50							Dry Drilling
21			do		21.0	SPT-21	42	1	3	3	5	8	15	
			Clayey SILT / Silty Clay, greyish, medium plasticity, little or traces of fine grained sand with little mica		21.5		45							Dry Drilling
22			do		22.0	SPT-22	40	2	3	3	5	8	12	
			do		22.5		50							Dry Drilling
23			do		23.0	SPT-23	50	2	4	4	7	9	18	
			do		23.5		50							Dry Drilling
24	BW (75 mm)				24.0									

Legend:
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturned Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 16, 2001 | Date Completed: April 20, 2001

Figure No

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GEOCE Consultants (P) Ltd.
SOIL DRILLING LOG

BOREHOLE NO : BH - 5
Sheet 5 of 5

Project: The Study on Earthquake Disaster Mitigation in Kathmandu Valley | Location : Bhaktapur | Feature : Sunny

Type of Equipment & Methods : KOKEN, Rotatory Double Core Barrel

Diameter of Borehole: 99 mm | Inclination of Borehole: | Coordinates: | Reference Details: at Durbar Square in front of Bhaktapur Municipality

R.L. of Borehole : m | 90 degree

Drilling Process	Casing depth & size	Water Level	Description of Strata	Symbol	Legend & Thickness	Sample/Test Type	Rec. (cm)	SPT Test Records 5 cm	10 cm	10 cm	10 cm	15 cm	SPT N value	Water Recovery
		meter			meter									
24	BW (75 mm)	5.6	Clayey SILT / Silty Clay, greyish, medium plasticity, little or traces of fine grained sand with little mica, stiff		24.0	SPT-24	48	3	4	4	5	7	14	Dry Drilling
04/20	BW (75 mm)	10.0	do		24.5		50							
25			do		25.0	SPT-25	50	2	2	3	4	5	11	
			do		25.5		50							
26			do and highly compacted		26.0	SPT-26	48	1	1	3	3	5	10	
			do		26.5		50							
27			Clayey SILT / Silty Clay, greyish, high plasticity, little or traces of fine grained sand with little mica, stiff		27.0	SPT-27	50	1	3	3	2	4	7	
			do		27.5	UD - 1	50							
28			do		28.0	SPT-28	50	1	1	2	2	4	7	
			do		28.5		50							
29			do		29.0	SPT-29	50	1	1	2	3	5	8	
			do		29.5	UD - 2	40							
4/20	BW (75 mm)	4.00												Dry
30		4.50	End of Borehole		30.0	SPT-30	50	1	2	3	4	7	13	Drilling

Legend
RE : Sample Recovery
D : Disturbed Sample
UD : Undisturbed Sample
SPT : SPT
SPT(C) : SPT with Cone

Remarks:

Logged By

Date Started : April 16, 2001

Date Completed: April 20, 2001

Figure No

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