APPENDIX

APPENDIX 1 HISTORY OF DISASTER OCCURRENCE

Table of Contents

APPENDIX I

HISTORY OF DISASTER OCCURRENCE

1.1 COLLECTION OF DISASTER OCCURRENCE DATA

The date and reports shown as Table 1.1.1 were collected.

Table 1.1.1 The Collected Date and Reports

No.	Title	Composed date	Media	Composer
1	Monthly Progress Report No.1,10 ~ 20, 23,28	Jan. 2002 ~ Apr. 2004	Paper	HAZMA / TAISEI JV
2	The slope failure site around Sta. 18+200 (Japanese)	Nov. 2003	Paper	NIPPON KOEI
3	Disaster Survey Report in Sep. 2004 (Japanese)	Oct. 2004	CD-R	NIPPON KOEI
4	Disaster in Section II on 11 Jan. 2006 (Japanese)	Aug. 2005	CD-R	NIPPON KOEI
5	Final Report n Boring Works at Dhungre-Bhanjyang	Dec. 2005	Paper	HAZMA / TAISEI JV
6	Design for Countermeasure of Disaster in Jul.2004 (Japanese)	Jul. 2004	Paper	NIPPON KOEI
7	The survey of deformed structures on Sindhuli road (Section II) Aug. 2005 (Japanese)	Aug. 2005	Paper	NIPPON KOEI
8	Record of Deformations on Section II and Countermeasures for Sta.17+600, Sta.18+200 and Sta.21+600	Dec. 2007	Paper	NIPPON KOEI

Source: study team

1.1.1 HISTORY OF DISASTER OCCURRENCE FOR STA.17+400

The history of the slope failure shows as Table 1.1.2 and Figure 1.1.1.

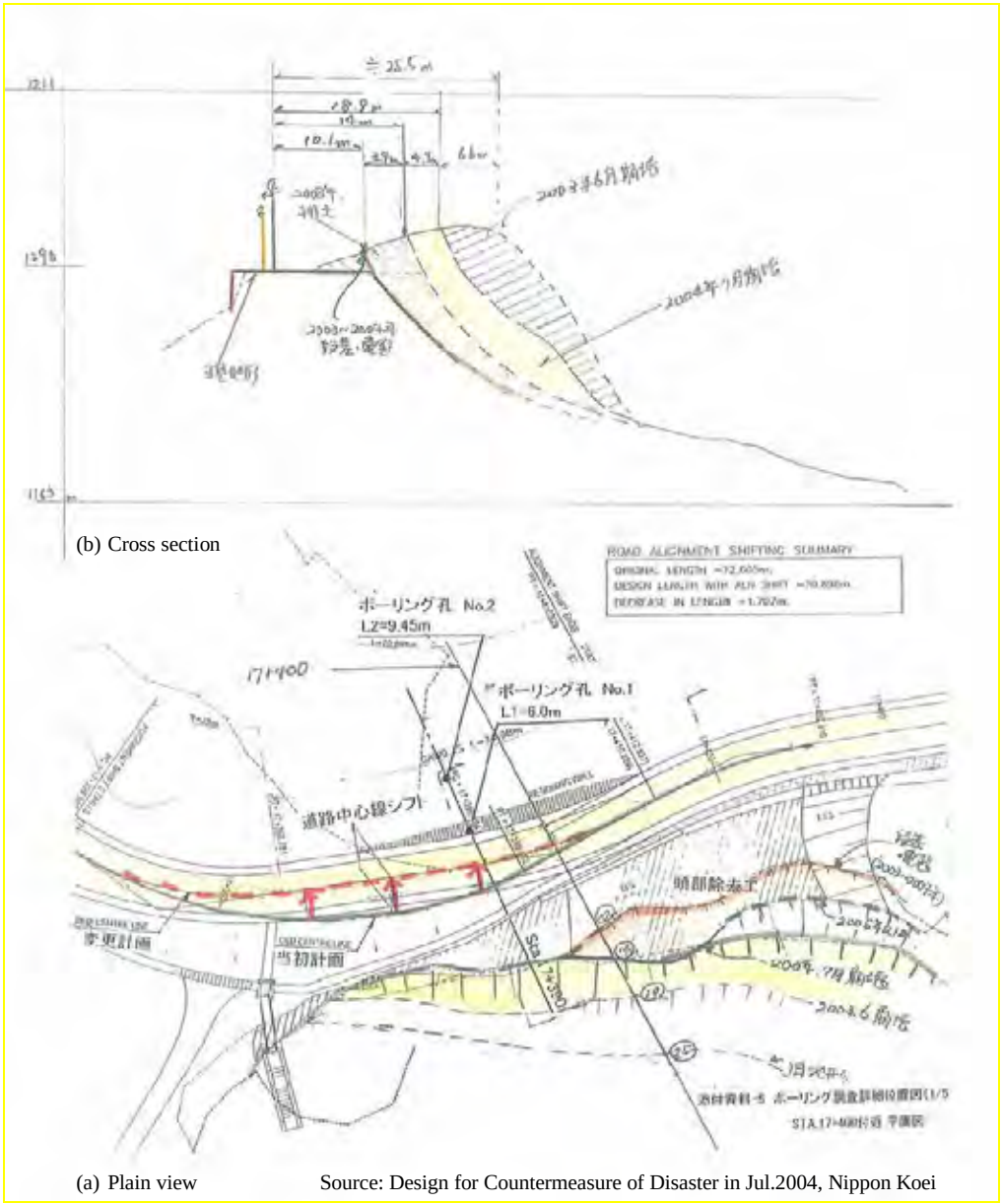
The slope failure occurred in June 2003 firstly has gradually expanded with rainfall. The retaining wall and shotcrete were constructed as countermeasures in May 2005, but was damaged with later heavy rainfall. Therefore, the road realignment and removal of unstable soil mass were executed. The slope failure has hardly expanded since execution of the countermeasures and no crack has occurred.

The shotcrete and a soil mass under the retaining wall fell on 14th July 2010 during this study period. However, this failure didn't damage the road.

Table 1.1.2 History of Disaster Occurrence for Sta.17+400

Date	Event
June 2003	The slope failure occurred. The cliff formed on approximately 20m from center of the road, cracks also occurred on approximately 10m from center of the road.
July 2004	The failure expanded. The cliff had expanded approximately 10m since June 2003.
May 2005	The retaining wall and shotcrete were constructed by the Hazama-Taisei JV.
August to September 2005	The Slope failure occurred again. The retaining wall and shotcrete fell.
2006	The road realignment and removal of unstable soil mass were constructed by the Hazama-Taisei JV.

Source: study team



(b) Cross section

(a) Plain view

Source: Design for Countermeasure of Disaster in Jul.2004, Nippon Koei

Figure 1.1.1 Schematic view of history of slope failure at Sta.17+400

1.1.2 HISTORY OF DISASTER OCCURRENCE FOR STA.17+600

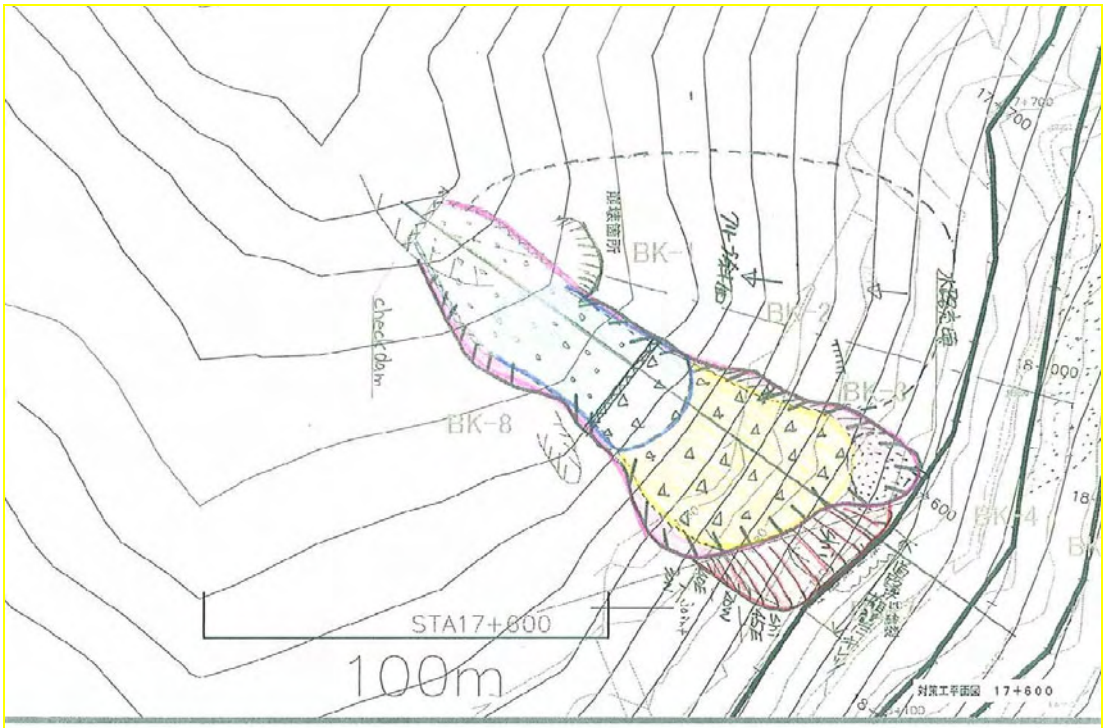
The history of the slope failure for Sta. 17+600 shows as Table 1.1.3 and Figure 1.1.2.

The failure which occurred on lower slope in August 2007 first has gradually expanded with rainfall, reached the road in September of that year. After that, small-scale failure has occurred. Three check dams were constructed in the failed valley in May 2008 and shotcrete and rock bolt works were constructed on the scarp of the upper failure slope in May 2009. However, new failure occurred on the steep slope of the head of failure in July 2009. Cracks is expanding and occurring on the retaining wall and drainage of mountain side now, part of the road has been loosened by the slope failure.

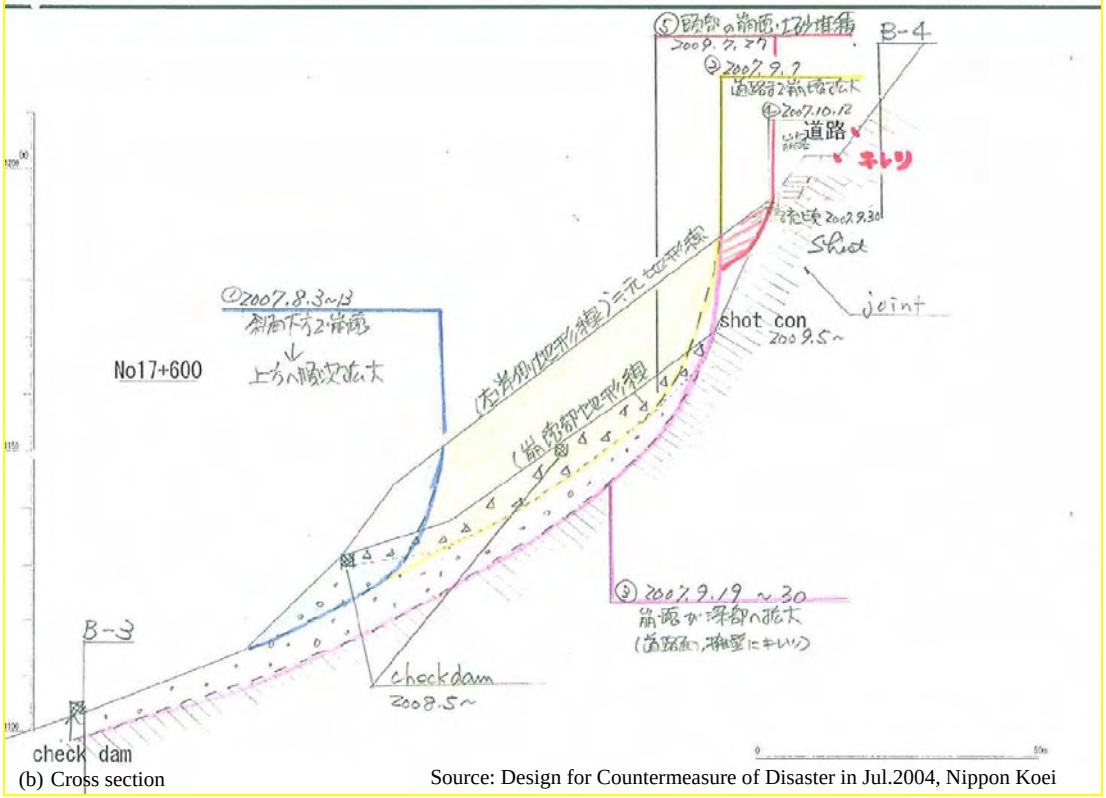
Table 1.1.3 History of Disaster Occurrence for Sta.17+600

Date	Event
August 2007	The slope failure occurred on lower slope and has gradually expanded upward.
September 2004	The failure expanded up to the road. The cracks occurred on the retaining wall and the road surface.
October 2007	Small-scale failure occurred on the scarp.
May 2008	Three check dams were executed as emergency countermeasures by DoR.
May 2009	Shotcrete and rock bolt works were executed as emergency countermeasures by DoR.
July 2009	New failure occurred on the head of slope and sediment deposited in the failed valley.

Source: study team



(c) Plain view



(b) Cross section

Source: Design for Countermeasure of Disaster in Jul.2004, Nippon Koei

Figure 1.1.2 Schematic view of history of slope failure at Sta.17+600

1.1.3 HISTORY OF DISASTER OCCURRENCE FOR STA.18+200

The history of the slope failure for Sta.18+200 is shown as Table 1.1.4 and Figure 1.1.3.

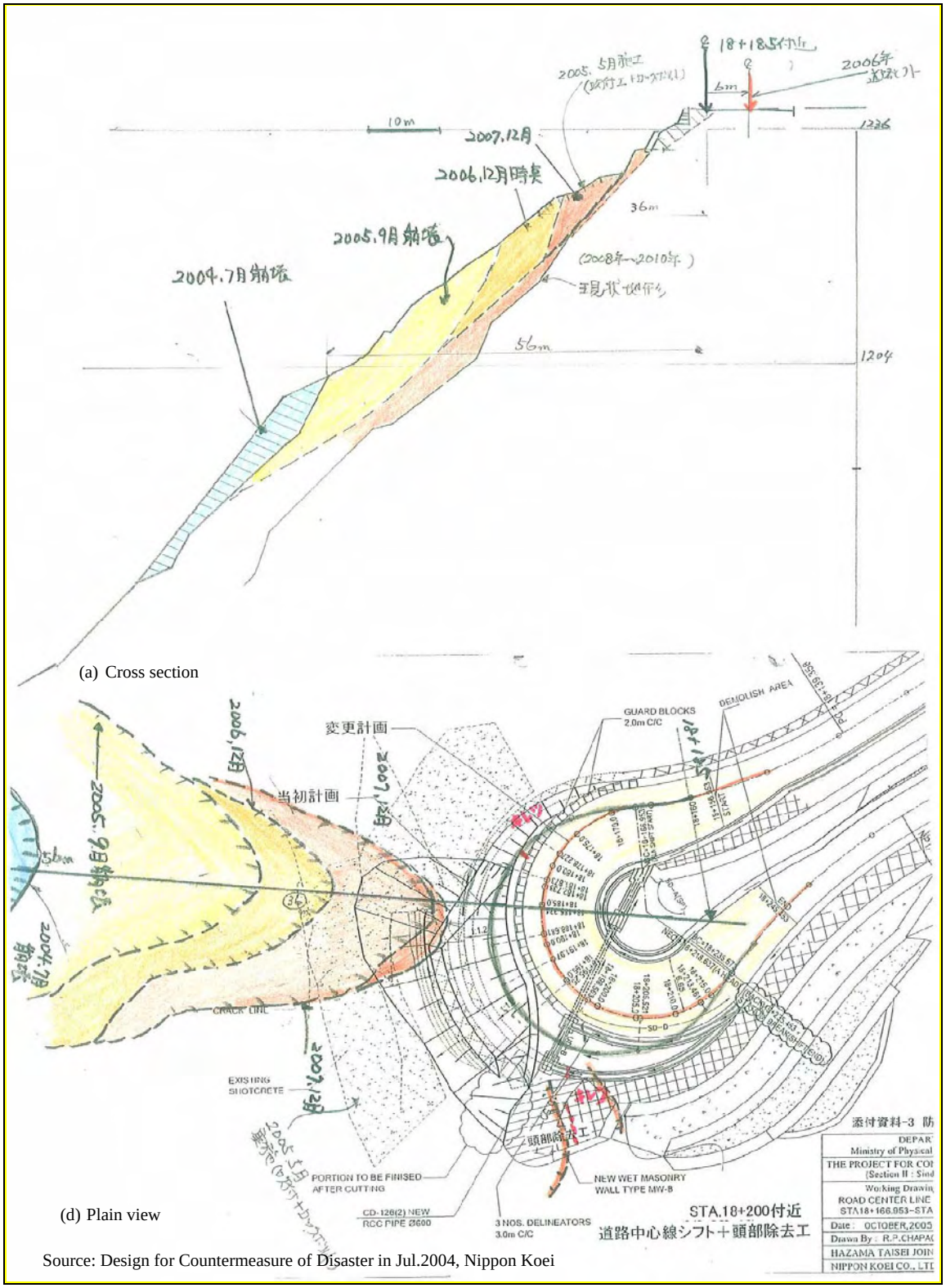
The slope failure had occurred lower slope from November 2003 to July 2004 first. The shotcrete with rock bolt works was constructed as countermeasures in May 2005. After that, the slope failure occurred lower shotcrete slope again with rainfall in August 2005, cracks occurred on the road surface.

In July 2008, one of the crack width on the retaining wall at Sta.18+200 expanded 48mm, however, it was 7mm in June 2010.

Table 1.1.4 History of Disaster Occurrence for Sta.18+200

Date	Event
November 2003	The scarp formed on approximately 30m from center of the road, cracks also occurred on approximately 5m behind the scarp.
July 2004	The failure occurred on the shotcrete and soil slope.
May 2005	The shotcrete and rock bolt works were constructed by the Hazama-Taisei JV.
August to September 2005	The Slope failure occurred on lower shotcrete slope again. The cracks occurred on the shotcrete, the foundation of the retaining wall and the road surface.
2006	The road realignment of approximately 6m on mountain side was executed by the Hazama-Taisei JV.
December 2007	The failure on the shotcrete and the surface failure on the soil slope expanded.

Source: study team



(a) Cross section

(d) Plain view

Source: Design for Countermeasure of Disaster in Jul.2004, Nippon Koei

Figure 1.1.3 Schematic view of history of slope failure at Sta.18+200

1.2 PHOTOS

18 August 2005

13 September 2005

15 September 2005

17 January 2006

26 November 2007

19 August 2008

11 June 2010

27 August 2010

3 August 2007

7 September 2007

19 September 2007

30 September 2007

26 November 2007

May 2009

27 July 2009

17 August 2010

March 2003

16 December 2005

June 2009

21 August 2010

APPENDIX 2 GEOLOGICAL SURVEY

Table of Contents

APPENDIX II

GEOLOGICAL SURVEY

2.1 GEOLOGICAL MAP

The geological map around the studied landslide is shown as Figure 2.1.1. The metamorphic rocks belonging in the Raduwa Formation of Pre-Cambrian distribute on the studied area. They are divided into some facies by lithology, quartzite schist, green schist, mica schist and augen gneiss in ascending order.

Table 2.1.1 shows character and engineering property of each rock facies.

Table 2.1.1 Character and Engineering Property of Lithofacies

Location	Lithofacies	Character	Engineering Property	Boundary
Upper	Schist with wide schistosity	Light grey blue Base rock: sandstone Thickness of strata is more than 10cm in width	Very hard and fresh. Sheeting joints are developed. Wedged failures with schistosity and joint occurred	
Sta17+700				Fracture zone with foliated structure 2m in width
Sta17+560	Schist with tight schistosity	Light grey blue (dark brawn on weathered part). Base rock: sandstone Thickness of strata is 5mm~10cm in width	Due to thin strata, bending often occur on back slope. The progress of weathering is fast due to the tight schistosity.	
Sta17+440				Sharp bedding plane
	Augen gneiss	Light white grey. Augen structure comprised of biotite, muscovite, and quartz. quartz vein	Resistant to weathering. Consist of steep slope due to hard and fresh.	
Sta17+420				Gradual change
	Mica schist	Dark brown ~ dark grey. Due to intense re-crystalline grain site is very coarse (biotite, muscovite and quartz) Foliated structure biotite along the schistosity 1mm~a few mm interval between schistosity	The progress of weathering is fast due to the tight schistosity. Collapses fell away along the biotite cleavage due to congestion of exfoliative biotite along schistosity,.	
Sta17+360				Sharp bedding plane
	Green schist	Light green Base rock: sandstone Many shear plane and microscopic-fold Quartz vein Some part is massive, other have crenulation cleavage	Spring water has occurred due to difference of water permeability with the lower schist. Resistant to weathering due to siliceous.	
Sta17+320				Sharp and gentle shear plane (thrust) cuts schistosity of lower schist.
	Quartzite schist	Quartzite-fine grained schist sequence with black schist Dark brown ~ light white grey Base rock: sandstone and mudstone Kink fold of outcrop scale Thickness of strata is a few cm ~ 10cm	Resistant to weathering and fresh on outcrop due to quartzite produced by crystalline.	
Sta17+300				
Lower				

Source: study team

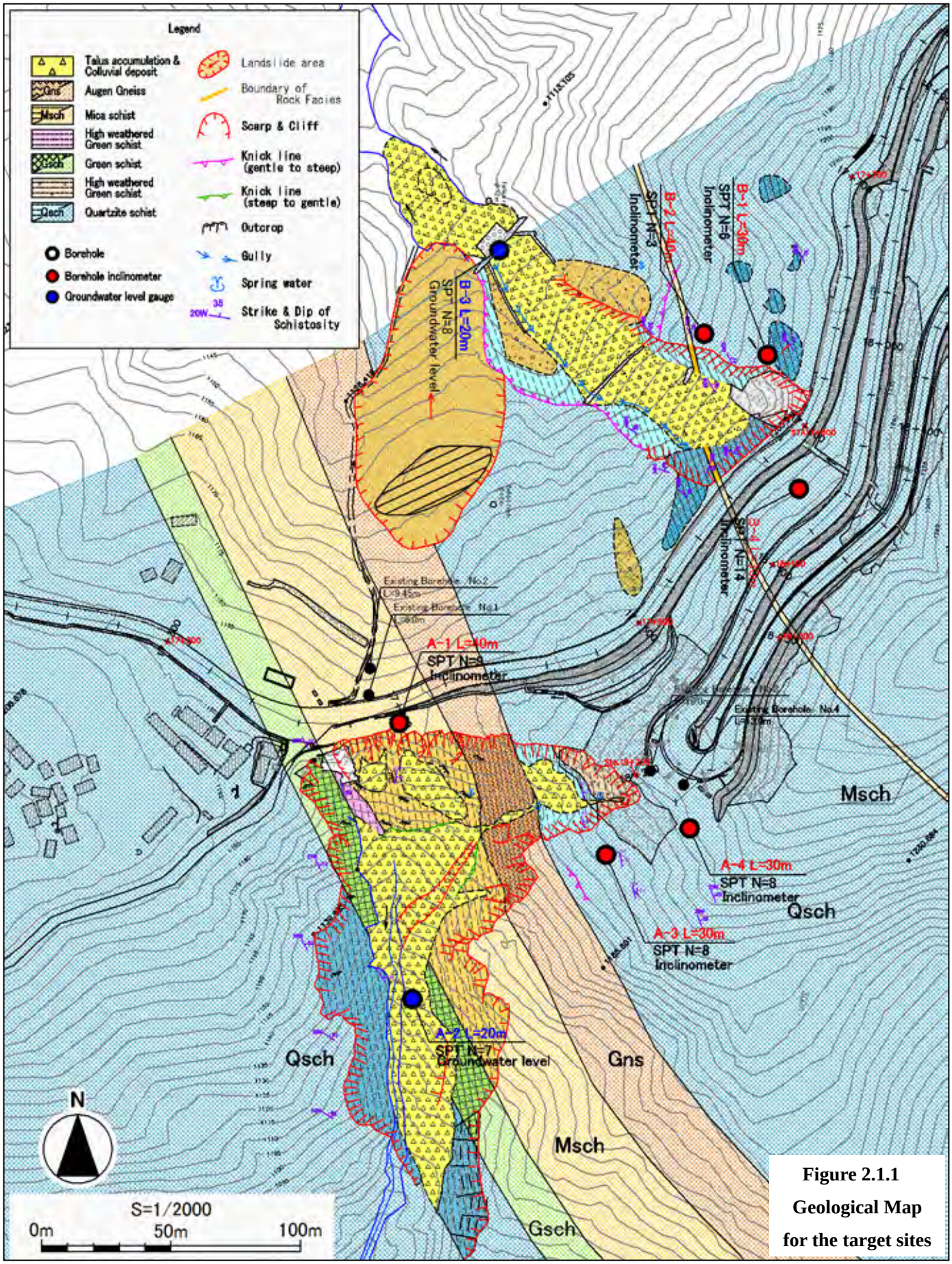
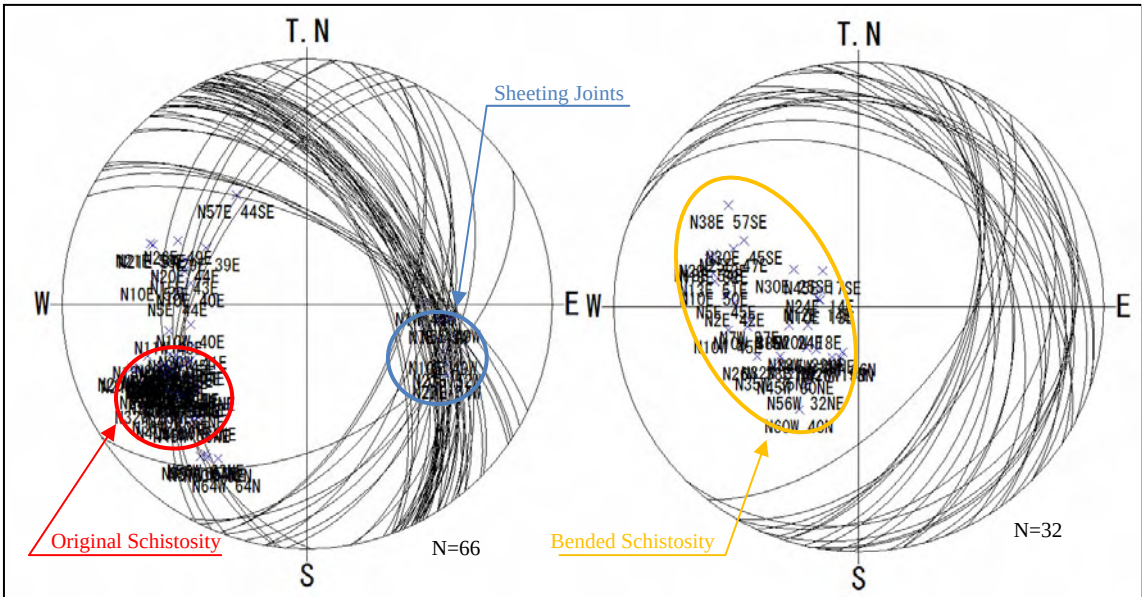


Figure 2.1.1
Geological Map
for the target sites

Figure 2.1.1 shows the contour map of schistosity measured on schist and gneiss outcrops in the studied site.

The original schistosity of fresh and intact schist and gneiss is generally distributed in a direction of north-northwest to south southeast and dipping northeast with angles of 40 – 65 degrees. And in upper quartzite schist sheeting joints which is north northeast to south southwest in direction and dipping west with angles 40 -50 degrees were developed. On the other hand, the trends of schistosity in weathered rock slope show dispersive on the stereographic projection and comparatively gentle dip due to bending by creep.



(a) Fresh rocks of schist and gneiss (b) Weathered rocks of schist and gneiss

Source: Study team Schmidt net; lower hemisphere projection

Figure 2.1.1 Contour Map of Schistosity in the Studied Site

2.2 DRILLING SURVEY

Eight points of the drilling survey were conducted as shown as Table 2.2.1.The boring loges are shown as the following pages.

Table 2.2.1 Drilling Survey

Location	Borehole	Drilled Depth	Monitoring Devices
Sta.17+400	A-1	40m	Borehole Inclinometer
	A-2	20m	Ground Water Gauge
Sta.17+600	B-1	30m	Borehole Inclinometer
	B-2	40m	Borehole Inclinometer
	B-3	20m	Ground Water Gauge
	B-4	30m	Borehole Inclinometer
Sta.18+200	A-3	30m	Borehole Inclinometer
	A-4	30m	Borehole Inclinometer

Source: study team

BOREHOLE LOG: A1

Sindhuli Road (II)

Borehole No.: A1 — Drilling Machine: Voldrill

Inclination: Vertical — Drilling Method: Rotary

Total depth: 40 m — Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	Brownish grey clayey sand	Mw	-	-	-	-	-	-	-	-	-	Loss	Contineous Side Fall, casing inserted only 17.0 m depth
2	1-2	Brown coarse sand (Feldspar, Quartz)	Mw	-	-	-	-	-	3	4	3	10		
3	2-2.05 2.05-3	Brown grey coarse sand	Mw	-	-	-	-	-	3	4	3	10		
4	3-3.45 3.45-4	No Recovery	-	-	-	-	-	-	3	4	3	10		
5	4-5	No Recovery	-	-	-	-	-	-	50/10			>50		
6	5-6	No Recovery	-	-	-	-	-	-	50/6			>50	Return	
7	6-7	No Recovery	-	-	-	-	-	-	50/8			>50		
8	7-8	Brown grey fine silty sand	Mw	-	-	-	-	-	50/9			>50		
9	8-9	No Recovery	-	-	-	-	-	-	50/6			>50		
10	9-10	Dark grey fine to medium sand	Hw	-	-	-	-	-	50/3			>50		
11	10-10.05 10.05-11	Dark grey to black clayey sand	Hw	-	-	-	-	-	50/5			>50		
12	11-12	Light grey silty clay	Hw	-	-	-	-	-	50/10			>50		
13	12-13	Light grey fine sand	Hw	-	-	-	-	-	-	-	-	-		
14	13-14	Grey sand (Fine)	Hw	-	-	-	-	-	-	-	-	-		
15	14-15	Grey sand (fine)	Hw	-	-	-	-	-	-	-	-	-		
16	15-16	Fractured, slightly weathered schist	Sw	-	7	9	-	52	-	-	-	-		
17	16-17	Brownish grey Fractured and slightly weathered quartz and schist	Sw	-	7	9	-	50	-	-	-	-		
18	17-18	Weatherd fine sand	Hw	-	-	-	-	-	-	-	-	-		
19	18-19	Medium grained sand (High Mica)	Mw	-	-	-	-	-	-	-	-	-		
20	19-20	Fine sand (High Mica)	Hw	-	-	-	-	-	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A1

Sindhuli Road (II)

Borehole No.: A1 | Drilling Machine: Voldrill

Inclination: Vertical | Drilling Method: Rotary

Total depth: 40 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % — Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Light grey fine sand sludge	Mw	-	-	-	-	-	-	-	-	-	Return	Moderately side fall from 24.0 m depth
22	21-22	Light grey fine sand sludge	Mw	-	-	-	-	-	-	-	-	-		
23	22-23	Light grey fine sand sludge	Mw	-	-	-	-	-	-	-	-	-		
24	23-24	No Recovery	-	-	-	-	-	-	-	-	-	-		
25	24-25	Grey clayey sand sludge	Hw	-	-	-	-	-	-	-	-	-		
26	25-26	Grey clayey sand sludge	Hw	-	-	-	-	-	-	-	-	-		
27	26-27	Grey clayey sand sludge	Hw	-	-	-	-	-	-	-	-	-		
28	27-28	Grey clayey sand sludge	Hw	-	-	-	-	-	-	-	-	-		
29	28-29	Grey clayey sand sludge	Hw	-	-	-	-	-	-	-	-	-		
30	29-30	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
31	30-31	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
32	31-32	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
33	32-33	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
34	33-34	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
35	34-35	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
36	35-36	Dark grey medium sand sludge (High Mica)	-	-	-	-	-	-	-	-	-	-		
37	36-37	Brown grey fine sand and silty sand sludge	-	-	-	-	-	-	-	-	-	-		
38	37-38	Brown grey fine sand and silty sand sludge	-	-	-	-	-	-	-	-	-	-		
39	38-39	Brown grey fine sand and silty sand sludge	-	-	-	-	-	-	-	-	-	-		
40	39-40	Brown grey fine sand and silty sand sludge	-	-	-	-	-	-	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A2

Sindhuli Road (II)

Borehole No.: A2 — Drilling Machine: Toho/Koken

Inclination: Vertical — Drilling Method: Rotary

Total depth: 20 m — Water Table: 4.0-5.0 m

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	Filling rock fragements schist/ Quartzite	Mw	-	-	-	-	-	-	-	-	-	Loss	Side fall happens and hole goes slightly out
2	1-2	Dark grey rock fragments Schist and quartzite (Deposited)	Sw	-	-	-	-	-	-	-	-	-		
3	2-3	Brown grey medium sand sludge	W	-	-	-	-	-	-	-	-	-		
4	3-4	Brown grey medium sand sludge	W	-	-	-	-	-	5	23	29	>50		
5	4-5	Brown grey medium sand sludge	W	-	-	-	-	-	3	27	27	>50		Boulder strata as unusual drilling
6	5-6	Brown grey fine sand sludge	W	-	-	-	-	-	5	30	38	>50		
7	6-7	Brown grey fine sand sludge	W	-	-	-	-	-	8	22	30	>50		
8	7-8	Brown grey fine sand sludge	W	-	-	-	-	-	10	16	38	>50		
9	8-9	Brown grey fine sand sludge	W	-	-	-	-	-	20	24	40	>50		
10	9-10	Brown grey fine sand sludge and highly weathered schist fragments	Hw	-	3	4	-	-	15	23	40	>50		From 9.2 slightly easy in drilling
11	10-11	Weathered rock fragments of fine grain quartzite	Sw	-	3	7	-	-	50/7			>50		
12	11-12	Grey fine grained quartzite	Sw	-	3	9	-	-	-	-	-	-		
13	12-13	Grey fine grained quartzite	Sw	-	1	8	-	-	-	-	-	-		Slighly difficult to drill
14	13-14	Grey fine grained quartzite	Sw	-	1	8	-	-	-	-	-	-		
15	14-15	Grey fine grained quartzit and schist	Sw	-	1	9	-	-	-	-	-	-		
16	15-16	Fresh dark grey fragmets of schist	F	-	4	6	-	68	-	-	-	-		Contineous and rapid drilling
17	16-17	Fresh dark grey fragmets of schist	F	-	2	7	-	62	-	-	-	-		
18	17-18	Fresh dark grey fragmets of schist	F	-	1	7	-	70	-	-	-	-		
19	18-19	Fresh dark grey fragmets of schist	F	-	2	7	-	70	-	-	-	-		
20	19-20	Fresh dark grey fragmets of schist	F	-	3	26	-	67	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered
FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A3

Sindhuli Road (II)

Borehole No.: A3 | Drilling Machine: Toho/Koken

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD % — Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	Fine sand sludge	-	-	-	-	-	-	-	-	-	-	Return	
2	1-2	Colluvial (Fragments of schist gneiss)	Sw	-	4	13	-	-	50/3			>50		
3	2-3	No Recovery		-	-	-	-	-	50/5			>50	Loss	
4	3-4	Fracture rocks of schist/gneiss and clayey sludge	Sw	-	6	65	-	35	50/4			>50		
5	4-5	Weathered fractured schist and gneiss	Sw	-	3.5	20	-	22	50/3			>50		
6	5-6	Weathered fractured schist and fine sand sludge	Mw	-	3	20	-	40	30	50/5		>50	Return	
7	6-6.45 6.45-7	Weathered fractured schist and fine sand sludge	Mw	-	4	15	-	38	13	19	48	>50		
8	7-8	Weathered fractured schist and fine sand sludge	W	-	2	5	-	34	-	-	-	-	Loss	
9	8-9	No Recovery	-	-	-	-	-	-	-	-	-	-		
10	9-10	No Recovery	-	-	-	-	-	-	-	-	-	-		
11	10-10.5 10.5-11	Clayey sand	-	-	6	30	-	35	17	16	17	50		
12	11-12	Highly weathered schist, contain biotite, muscobite, feldspar, quartz	Sw	-	7	20	-	37	-	-	-	-		
13	12-13	Highly weathered schist, contain biotite, muscobite, feldspar, quartz	Sw	-	10	15	10	32	-	-	-	-		
14	13-14	Highly weathered schist, contain biotite, muscobite, feldspar, quartz	Sw	-	5	40	-	30	-	-	-	-		
15	14-15	Brown grey soft, highly weathered and fractured schist, clayey sand	Sw	-	5	68	-	37	-	-	-	-	Return	
16	15-16	Slightly weathered fractures schist rock(Mica, Feltspar, Quartz)	Sw	-	3	25	-	32	-	-	-	-		
17	16-17	Slightly weathered fractures schist rock(Mica, Feltspar, Quartz)	Sw	-	3	25	-	33	-	-	-	-		
18	17-18	Slightly weathered fractures schist rock(Mica, Feltspar, Quartz)	Sw	-	6	35	-	35	-	-	-	-	Loss	
19	18-19	No Recovery	-	-	-	-	-	-	-	-	-	-		
20	19-20	Weathered Schist	Sw	-	4	35	-	30	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A3

Sindhuli Road (II)

Borehole No.: A3 | Drilling Machine: Toho/Koken

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD % — Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Slightly weathered fractured schist, contain high Mica	Sw	-	5.5	20	-	30	-	-	-	-	Return	
22	21-22	Slightly weathered fractured schist, contain high Mica	Sw	-	5	35	-	32	-	-	-	-		
23	22-23	Slightly weathered fractured schist, contain high Mica	Sw	-	3	10	-	30	-	-	-	-		
24	23-24	No Recovery	-	-	-	-	-	-	-	-	-	-		
25	24-25	Weathered Schist	Sw	-	3	14	-	30	-	-	-	-		
26	25-26	Highly weathered to moderately weathered schist fragments	Hw	-	5	10	-	32	-	-	-	-	Loss	
27	26-27	Highly weathered to moderately weathered schist fragments	Hw	-	7	40	-	32	-	-	-	-		
28	27-28	Highly weathered to moderately weathered schist fragments	Hw	-	11	45	11	32	-	-	-	-		
29	28-29	Highly weathered to moderately weathered schist fragments	Hw	-	4	60	-	32	-	-	-	-		
30	29-30	Highly weathered to moderately weathered schist fragments	Hw	-	4	42	-	32	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered
FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A4

Sindhuli Road (II)

Borehole No.: A4 | Drilling Machine: Boyles

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD % — Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	No Recovery	-	-	-	-	-	-	-	-	-	-	Loss	Highly Fractured/Jointed/Weathered Quartzitic Schist
2	1-1.18 1.18-2	Fresh , fractured Schist Fragments	Sw	-	2	10	-	19	50/3			>50		
3	2-2.5 2.5-3	Fresh fractured Schist Fragments	-	-	3	20	-	14	50/3			>50		
4	3-3.5 3.5-4	Fresh fractured Schist with medium sand	Sw	-	3	20	-	30	50/4			>50		
5	4-4.5 4.5-5	Fresh Schist / sludge	Sw	-	4	20	-	22	50/10			>50		
6	5-5.25 5.25-5.5	Grey fresh and fractured schist	Sw	-	6.5	34	-	33	-	-	-	-		
7	5.5-6.3	Fresh to weathered schist	F	-	9.5	41	-	31	50/3			>50		
8	6.3-7.35 7.35-7.85	Fresh schist	F	-	4	37	-	33	-	-	-	-		
9	7.85-8.45 8.45-9	Fresh schist	F	-	5.5	-	-	37						
10	9-10	Fresh brown sand and fresh schist	F	-	3	20	-	25	50/6			>50		
11	10-11	Fragments of fresh schist	F	-	1.5	10	-	11	-	-	-	-		
12	11-12	Fresh fragments of schist	F	-	2	10	-	10						
13		Brown grey, medium sand sludge	-	-	-	-	-	-	50/7			>50		
14	12-13.5	Fresh to weathered schist fragments	F	-	2	8	-	13	-	-	-	-		
15	13.5-15	Light grey fine sand sludge and slightly weathered schist	Sw	-	1.5	9	-	12	-	-	-	-		
16	15-16	Fresh fragments of schist	F	-	1.5	9	-	-	-	-	-	-		
17	16-17	Fresh fragments of schist	F	-	2	7	-	8	-	-	-	-		
18	17-18	Fresh fragments of schist	F	-	4	20	-	27	-	-	-	-		
19	18-19	Fresh fragments of schist	F	-	3	10	-	15	-	-	-	-		
20	19-20	Fresh fragments of schist	F	-	1.5	19	-	10	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: A4

Sindhuli Road (II)

Borehole No.: A4 | Drilling Machine: Boyles

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Brown weathered schist fragments	Sw	-	2	18	-	12	-	-	-	-	Loss	Barrel Jam at 24.0 m/ Highly weathered Black coloured plasti clay to white milky fine grain quartzite encountered at that dep
22	21-22	Brown weathered schist fragments	Sw	-	1	10	-	15	-	-	-	-		
23	22-23	Brown weathered schist fragments	Sw	-	-	12	-	5	-	-	-	-		
24	23-23.8	Schist fragments with silty sand	Sw	-	4	4	-	25	-	-	-	-		
	24-24.5	Dark black plastic clay to weathered	Sw	-	6	6	-	30	50/2			>50		
25	24.5-25	white to milky fine grained quartzite												
26	25-26	White-milky fine grain quartz (More feldspar)	F	-	2	2	-	10	-	-	-	-		
27	26-27	White-milky fine grain quartz (More feldspar)	F	-	-	-	-	-	-	-	-	-		
	27-27.5	No recovery	-	-	-	-	-	-	-	-	-	-		
28	27.5-28													
29	28-29	No Recovery	-	-	-	-	-	-	-	-	-	-		
30	29-30	No recovery	-	-	-	-	-	-	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered
FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B1

Sindhuli Road (II)

Borehole No.: B1 | Drilling Machine: Toho/Koken

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD % — Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	No Recovery	-	-	-	-	-	-	-	-	-	-	Loss	Sudden fall of approx. 10 cm, Like drilling in gravelly boulder void area.
2	1-2	Light grey sand to rock fragments	-	-	-	-	-	-	50/5			>50		
3	2-3	Brownish grey fine sand with rock fragments	-	-	-	-	-	-	50/8			>50		
4	3-4	Slightly weathered rock fragments of quartzite	Sw	-	2	33	-	10	50/5			>50		
5	4-5	Slightly weathered rock fragments of quartzite	F-Sw	-	1	5	-	-	50/5			>50		
6	5-6	Fresh to slightly weathered rock of quartzitic schist	F	-	-	-	-	-	50/5			>50		
7	6-6.6 6.6-6.8	Fresh to slightly weathered rock of quartzitic schist	F	-	7	70	-	32	50/4			>50		
8	6.8-7.4	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	11	90	11	25	-	-	-	-		
9	7.4-8.35 8.35-9.0	Fresh to slightly weathered rock of quartzitic schist	Sw	-	15	90	15	22	-	-	-	-		
10	9-9.3	Fresh to slightly weathered rock of quartzitic schist	Sw	-	11	50	11	28	-	-	-	-		
11	9.3-10.2 10.2-11	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	14	65	14	25	-	-	-	-		Slightly Barrel Jam, at 18.0 m depth
12	11-12	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	12	50	12	24	-	-	-	-		
13	12-13	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	10	50	10	22	-	-	-	-		
14	13-14	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	15	45	15	26	-	-	-	-		
15	14-14.65 14.65-15	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	10	25	10	22	-	-	-	-		
16	15-16	Fresh to slightly weathered rock of quartzitic schist	Sw	-	4	18	-	32	-	-	-	-		
17	16-17	Fresh to slightly weathered rock of quartzitic schist	Sw	-	10	35	10	18	-	-	-	-		
18	17-18	Slightly weathered fractures of quartzitic schist	Mw	-	10	59	10	17	-	-	-	-		
19	18-19	Light grey fine grain sand and sludge	-	-	-	-	-	-	-	-	-	-	Return	Comparitively fast drilling
20	19-20	No recovery	-	-	-	-	-	-	-	-	-	-	Loss	

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B1

Sindhuli Road (II)

Borehole No.: B1 | Drilling Machine: Toho/Koken

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Light grey to weathered rock fragment	Mw	-	8	50	-	32	-	-	-	-	Loss	
22	21-22	Light grey to weathered rock fragments of quartzitic schist	Sw	-	4	45	-	52	-	-	-	-		
23	22-23	Light grey to weathered rock fragments of quartzitic schist	Mw	-	9	45	-	32	-	-	-	-		
24	23-24	Grey fine Sand and rock fragments of quartzitic schist	Mw	-	1	15	-	-	-	-	-	-	Return	
25	24-25	Brown to grey medium sand fragments and sludge	Mw	-	1	20	-	-	-	-	-	-		
26	25-26	Sludge form	-	-	-	-	-	-	-	-	-	-		
27	26-27	Slightly weathered fragments of quartzitic schist	Sw	-	7	60	-	55	-	-	-	-		
28	27-27.5 27.5-28	Slightly weathered fragments of quartzitic schist	Sw	-	3	8	-	-	-	-	-	-	Loss	
29	28-29	Slightly weathered fragments of quartzitic schist	Sw	-	3	13	-	-	-	-	-	-	Return	
30	29-30	Slightly weathered fragments of quartzitic schist	Sw	-	5	72	-	60	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered
FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B2

Sindhuli Road (II)

Borehole No.: B2 — Drilling Machine: Toho/Koken

Inclination: Vertical — Drilling Method: Rotary

Total depth: 40 m — Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
1	0-1	No Recovery	-	-	-	-	-	-	-	-	-	-	Loss	Casing and Barrel both Jam at 13.4 m depth/ expected to be small void or slip / Fro 12.5m to 13.4 m depth casing drilled within 15 mins time, without any pressure(Only rotation).
2	1-2	No Recovery	-	-	-	-	-	-	50/2			>50		
3	2-3	Fragmets of quartzitic schist	-	-	2	10	-	-	50/3			>50		
4	3-3.85 3.85-4.35	Fresh fractured quartzitic schist	F	-	5	37	-	60	50/5			>50		
5	4.35-4.85 4.85-5	Fresh quartzitic schist to slightly weathered grey fine grained quartzitic	F-Sw	-	10	65	10	60	-	-	-	-		
6	5-5.45, 5.49-5.73, 5.73-6	Fresh quartzitic schist to slightly weathered grey fine grained quartzitic	F-Sw	-	14	65	14	32	-	-	-	-		
7	6-6.6 6.6-7	Fresh grey to light grey fractured quartzitic schist with gneiss traces	F-Sw	-	7	28	-	50	-	-	-	-		
8	7.0-7.45 7.45-8	Fresh grey to light grey fractured quartzitic schist	F-Sw	-	9	43	-	55	-	-	-	-		
9	8-9	Fresh grey to light grey fractured quartzitic schist	F-Sw	-	8	18	-	50	-	-	-	-		
10	9-9.75 9.75-10	Fresh grey to light grey fractured quartzitic schist	F-Sw	-	4	19	-	50	-	-	-	-	Retur	
11	10-10.6 10.6-11	Fresh fracture grey to dark grey schist	F-Sw	-	6	35	-	32	-	-	-	-		
12	11-11.45 11.45-12	Fresh fracture grey to dark grey schist	F-Sw	-	6	32	-	30	-	-	-	-		
13	12-13	Fresh fracture grey to dark grey schist	F-Sw	-	10	33	10	30	-	-	-	-		
14	13-13.4 13.4-14	Fresh fracture grey to dark grey schist	F-Sw	-	6	22	-	30	-	-	-	-		
15	14-15	No Recovery	-	-	-	-	-	-	-	-	-	-	Loss	
16	15-16	Slightly weathered fragment of schist	Sw	-	2	-	-	35	-	-	-	-		
17	16-16.55 16.55-17	Slightly weathered fragment of schist	Sw	-	4	-	-	35	-	-	-	-		
18	17-18	Slightly weathered light grey to dark grey schist	Sw	-	8	-	-	35	-	-	-	-		
19	18-18.8 18.8-19	Slightly weathered light grey to dark grey schist	Sw	-	7	-	-	35	-	-	-	-		
20	19-20	Slightly weathered light grey to dark grey schist	Sw	-	6	-	-	35	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B2

Sindhuli Road (II)

Borehole No.: B2 | Drilling Machine: Toho/Koken

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Fresh to slightly weathered rock of qu	F-Sw	-	7	15	-	58	-	-	-	-		
22	21-22	Fresh to slightly weathered rock of quartzitic schist	F-Sw	-	5	18	-	55	-	-	-	-		
23	22-23	Grey to light grey rock fragments of fine grained quartzitic schist	F-Sw	-	8	30	-	55	-	-	-	-		
24	23-24	Grey to light grey rock fragments of fine grained quartzitic schist	F-Sw	-	5	21	-	50	-	-	-	-		
25	24-25	Grey to light grey rock fragments of fine grained quartzitic schist	F-Sw	-	5	30	-	55	-	-	-	-	Loss	
26	25-26	Grey to light grey rock fragments of fine grained quartzitic schist	Sw	-	2	15	-	30	-	-	-	-		
27	26-27	Grey to dark grey schist and dark grey clayey sand	F-Sw	-	8	10	-	-	-	-	-	-		
28	27-28	Grey to brown grey fine grained semi consolidated schist (sludge form)	F-Sw	-	-	-	-	-	-	-	-	-		
29	28-29	Slightly weathered fragments of quartzitic schist	F-Sw	-	-	-	-	-	-	-	-	-		
30	29-30	Slightly weathered fragments of quartzitic schist	F-Sw	-	-	-	-	-	-	-	-	-		
31	30-30.35 30.35-31	Slightly weathered fragments of quartzitic schist	-	-	-	-	-	-	-	-	-	-		
32	31-32	Slightly weathered fragments of quartzitic schist	-	-	-	-	-	-	-	-	-	-		
33	32-33	Slightly weathered fragments of quartzitic schist	-	-	-	-	-	-	-	-	-	-		
34	33-34	Slightly weathered fragments of quartzitic schist	-	-	-	-	-	-	-	-	-	-		
35	34-35	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-	Return	
36	35-36	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-		
37	36-37	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-		
38	37-38	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-		
39	38-39	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-		
40	39-40	Slightly weathered fragments of quartzitic schist (Sludge)	-	-	-	-	-	-	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B3

Sindhuli Road (II)

Borehole No.: B3 — Drilling Machine: Toho/Koken

Inclination: Vertical — Drilling Method: Rotary

Total depth: 20 m — Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD %				SPT				Permeability Water return or loss	Remarks/Test results
					Maximum Size, cm	REC %	RQD %	Dip Amount	10 cm	10 cm	10 cm	N value		
1	0-1	Filling rock fragements schist/ Quartzit	Hw	-	-	-	-	-	-	-	-	-	Loss	
2	1-2	Light grey to grey fresh fine grain quartzitic schist	F	-	1	7	-	10	50/4			>50		
3	2-3	Light grey to grey fresh fine grain quartzitic schist	F	-	10	15	10	19	50/6			>50		
4	3-4	Light grey to grey fresh fine grain quartzitic schist	F	-	5	23	-	35	50/5			>50		
5	4-5	Light grey to grey fresh fine grain quartzitic schist	F	-	2	15	-	22	50/3			>50		
6	5-6	Medium grained highly weathered deposit (Fine sand sludge)	Hw	-	4	6	-	20	50/4			>50		
7	6-7	Fresh fine grained grey quartzitic schist	F-Sw	-	3	5	-	20	50/3			>50		
8	7-7.5 7.5-8	Fresh fine grained grey quartzitic schist	F	-	8	12	-	10	-	-	-	-		
9	8-9	Fine grained, grey to green quartzitic schist	F	-	4	8	-	10	-	-	-	-		
10	9-9.3 9.3-10	Fine grained, grey to green quartzitic schist	F	-	5	17	-	16	50/4			>50		
11	10-11	Fine grained, grey to green quartzitic schist	F	-	6	30	-	18	-	-	-	-	Return	
12	11-12	Greenish grey quartzitic schist with garnet traces	F	-	7	9	-	18	-	-	-	-		
13	12-13	Grey to dark grey medium grain schist in form of sand (sludge)	Mw	-	-	-	-	-	-	-	-	-		
14	13-14	Grey to dark grey medium grain schist in form of sand (sludge)	Mw	-	-	-	-	-	-	-	-	-		
15	14-15	Fine grain grey to light grey schist (Sandy sludge)	Mw	-	-	-	-	-	-	-	-	-		
16	15-16	Dark grey fine grained schist (Sandy sludge)	Mw	-	-	-	-	-	50/6			>50		
17	16-17	Dark grey fine grained schist (Sandy sludge)	Mw	-	-	-	-	-	-	-	-	-		
18	17-18	Brown grained semiconsolidated fine grained schist (Sandy sludge)	Mw	-	-	-	-	-	-	-	-	-		
19	18-19	Dark brown grey semi consolidated fine grained schist (Sandy sludge)	Mw	-	-	-	-	-	-	-	-	-		
20	19-20	Dark brown grey semi consolidated fine grained schist (Sandy sludge)	Mw	-	-	-	-	-	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B4

Sindhuli Road (II)

Borehole No.: B4 | Drilling Machine: Voldrill

Inclination: Vertical | Drilling Method: Rotary

Total depth: 30 m | Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % / RQD %				SPT				Permeability Water return or loss	Remarks/Test results
					Maximum Size, cm	REC %	RQD %	Dip Amount	10 cm	10 cm	10 cm	N value		
1	0-1	Coarse grain brown to grey sandy sludge	Mw	-	-	-	-	-	-	-	-	-	Return	
2	1-2	Fine grain light grey schist (Sandy sludge)	Mw	-	-	-	-	-	50/7			>50		
3	2-3	Fine grain light grey schist (Sandy sludge)	Mw	-	-	-	-	-	50/9			>50		
4	3-4	Fine grain light grey schist (Sandy sludge)	Mw	-	-	-	-	-	50/3			>50		
5	4-5	Fresh fragments of quartzitic schist	Sw	-	6	10	-	-	50/4			>50		
6	5-6	Sludge weathered	-	-	-	-	-	-	50/6			>50		
7	6-7	Weathered and fractured quatzitic schist	Sw	-	2	4	-	40	50/3			>50	Water Loss from 6.2 m depth	
8	7-8	Medium grained fractured schists (Sandy sludge)	Sw	-	-	-	-	-	-	-	-	-		
9	8-9	No Recovery	-	-	-	-	-	-	-	-	-	-		
10	9-10	Weathered grey fractured quartzitic schist	Sw	-	3	6	-	42	50/5			>50		
11	10-11	Light grey weathered and fractured quartzitic schist	Sw	-	6	14	-	48	-	-	-	-		
12	11-12	Light grey weathered and fractured quartzitic schist	F-Sw	-	4	12	-	42	50/6			>50		
13	12-13	Light grey weathered and fractured quartzitic schist	F-Sw	-	7	12	-	45	-	-	-	-		
14	13-14	Light grey weathered and fractured quartzitic schist	F-Sw	-	-	-	-	-	-	-	-	-		
15	14-15	Light grey weathered and fractured quartzitic schist	F-Sw	-	2	6	-	48	-	-	-	-		
16	15-16	Light grey weathered and fractured quartzitic schist	F-Sw	-	4	10	-	35	50/3			>50		
17	16-17	Light grey weathered and fractured quartzitic schist	F-Sw	-	8	12	-	35	-	-	-	-		
18	17-18	Light grey weathered and fractured quartzitic schist	F-Sw	-	4	9	-	35	50/3			>50		
19	18-19	Light grey weathered and fractured quartzitic schist	F-Sw	-	5	10	-	35	-	-	-	-		
20	19-20	Light grey weathered and fractured quartzitic schist	F-Sw	-	13	10	13	35	-	-	-	-		

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered

FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

BOREHOLE LOG: B4

Sindhuli Road (II)

Borehole No.: B4 — Drilling Machine: Voldrill

Inclination: Vertical — Drilling Method: Rotary

Total depth: 30 m — Water Table: Not Available

Depth, m	Run Depth, m	Description of Rock/Soil	Alternation/Weathering	Filling Materials	Core Recovery % RQD % Maximum Size, cm	REC %	RQD %	Dip Amount	SPT 10 cm	SPT 10 cm	SPT 10 cm	SPT N value	Permeability Water return or loss	Remarks/Test results
21	20-21	Dark grey fractured rock with fine grai	F-Sw	-	8	14	-	30	50/4			>50	Loss	
22	21-22	Dark grey fractured rock with fine grained quartzite	F-Sw	-	2	14	-	30	-	-	-	-		
23	22-23	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	4	7	-	15	-	-	-	-		
24	23-24	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	3	5	-	25	50/3			>50		
25	24-25	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	5	10	-	25	-	-	-	-		
26	25-26	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	8	10	-	43	-	-	-	-		
27	26-27	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	2	10	-	42	50/3			>50	Return	
28	27-28	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	8	13	-	40	-	-	-	-		
29	28-29	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	8	12	-	45	50/4			>50		
30	29-30	Grey fine grained fresh to slightly weathered and fractured quartize with	F-Sw	-	10	40	10	45	-	-	-	-	Loss	

Abbreviations: F-Fresh, SW-Slightly Weathered, MW- Moderately Weathered, HW-Highly Weathered, CW-Completely Weathered
FZ- Fractured zone, MB-Mechnical Break, IR-Irregular, PI-Planar, Sm-Smooth, R-Rough, CL-Clay, Si-Silt, CL- Coreless

2.3 LABORATORY TEST

Laboratory tests shown as below were conducted. The result of laboratory tests is shown as the following pages. The samples picked in the site were shown as Table 2.3.1.

(1) Specific gravity of soil (ASTM D854, D136)

(2) Moisture content (ASTM, D4959)

(3) Particle size analysis by sieve and hydrometer (ASTM D422, C136)

(4) Test of Soil compaction using a rammer (JIS 1210)

Table 2.3.1 Samples for the Laboratory Tests

Location	Location	Condition
Sta.17+400	Around borehole of A-1	Gravel and soil
Sta.17+600	The bottom of B-3 survey line	High weathered rocks and soil

Source: study team

SPECIFIC GRAVITY TEST

Project : Landslide Monitoring
Location : Sindhuli Road Section II
Client : JICA

Sample No.		A1	A2	B1	B2
Depth, m		0.5	0.5	0.5	0.5
Wt. Pyconometer + Water + Soil	gm	180.92	180.26	173.00	180.00
Temperature T in c	°C	29	29	29	29
Wt. Pycnometer + Water	gm	162.10	161.40	154.30	161.40
Wt. Soil	gm	30.0	30.0	30.0	30.0
Specific Gravity of Water		0.9960	0.9960	0.9960	0.9960
Specific Gravity of Soil		2.673	2.682	2.644	2.621

NATURAL MOISTURE CONTENT

Project : Landslide Monitoring
Location : Sindhuli Road Section II
Client : JICA

Sample No.	Depth, m	Wt. of Cont. + Wet Soil	Wt. of Cont. + Dry Soil	Wt. of Water	Wt. of Empty Container	Wt. of Dry Soil	Moisture Content (%)
Borehole No	1						
B1	0.5	86.65	80.46	6.19	12.25	68.21	9.07
B2	0.5	84.23	80.16	4.07	13.00	67.16	6.06
A1	0.5	98.28	94.22	4.06	12.20	82.02	4.95
A2	0.5	95.55	88.83	6.72	11.90	76.93	8.74

GRAIN SIZE ANALYSIS

Test Method : IS: 2720 (Part 4) - 1985

Project : Landslide Monitoring

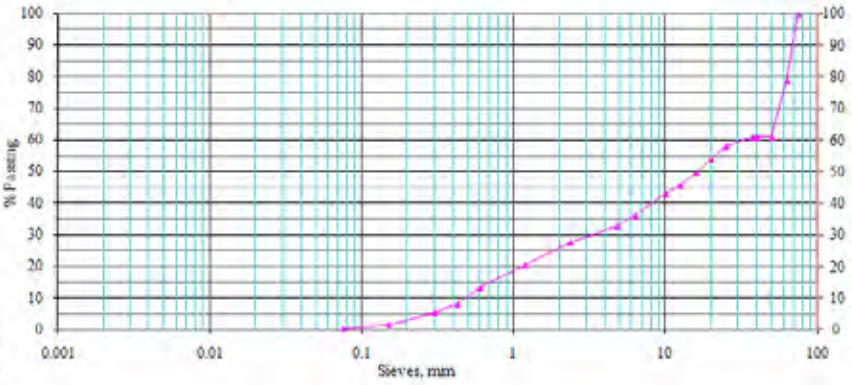
Location : Sindhuli Road Section II

Client : JICA

Borehole: 1 - A1

Depth: 0.50 m

Sieve	% Passing
75.000 mm	100.00
63.000 mm	78.87
50.000 mm	60.98
40.000 mm	60.98
37.500 mm	60.98
25.000 mm	58.01
20.000 mm	53.87
16.000 mm	49.65
12.500 mm	45.72
10.000 mm	42.96
6.300 mm	36.05
4.750 mm	32.60
2.360 mm	27.69
1.180 mm	20.51
0.600 mm	13.19
0.425 mm	7.94
0.300 mm	5.46
0.150 mm	1.59
0.075 mm	0.28
0.070 mm	
0.051 mm	
0.037 mm	
0.026 mm	
0.019 mm	
0.014 mm	
0.010 mm	
0.007 mm	
0.005 mm	
0.003 mm	
0.002 mm	
0.001 mm	



CLAY	SILT	SAND	GRAVEL
0.0 %	0.3 %	32.3 %	67.4 %

GRAIN SIZE ANALYSIS

Test Method : IS: 2720 (Part 4) - 1985

Project : Landslide Monitoring

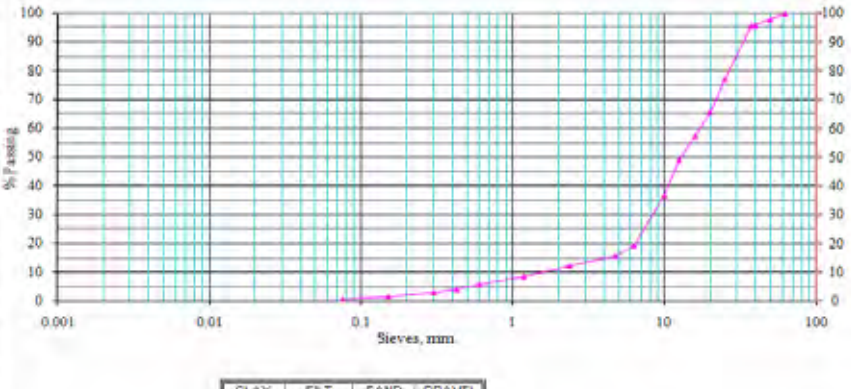
Location : Sindhuli Road Section II

Client : JICA

Borehole: 1 - A2

Depth: 0.30 m

Sieve	% Passing
75.000 mm	
63.000 mm	100.00
50.000 mm	97.86
40.000 mm	95.83
37.500 mm	95.83
25.000 mm	77.21
20.000 mm	65.66
16.000 mm	57.51
12.500 mm	49.07
10.000 mm	36.65
6.300 mm	19.29
4.750 mm	13.68
2.360 mm	12.18
1.180 mm	8.51
0.600 mm	5.74
0.425 mm	3.99
0.300 mm	2.98
0.150 mm	1.47
0.075 mm	0.53
0.070 mm	
0.051 mm	
0.037 mm	
0.026 mm	
0.019 mm	
0.014 mm	
0.010 mm	
0.007 mm	
0.005 mm	
0.003 mm	
0.002 mm	
0.001 mm	



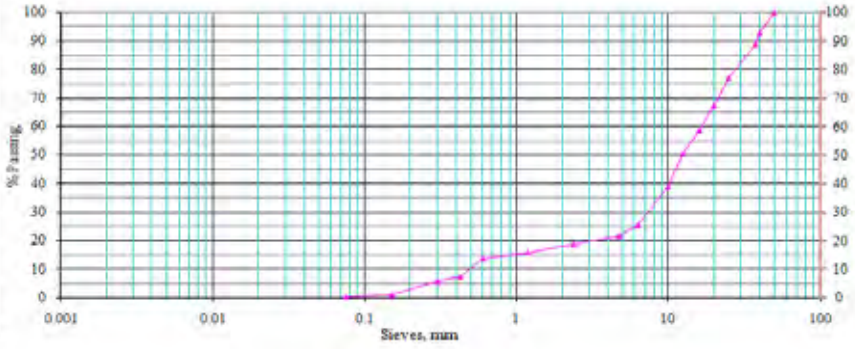
CLAY	SILT	SAND	GRAVEL
0.0 %	0.5 %	15.2 %	84.3 %

GRAIN SIZE ANALYSIS

Test Method : IS: 2720 (Part 4) - 1985
Project : Landslide Monitoring
Location : Sindhuli Road Section II
Client : JICA

Borehole: 1 - B1
Depth: 0.50 m

Sieve	% Passing
75.000 mm	
63.000 mm	
50.000 mm	100.00
40.000 mm	92.98
37.500 mm	88.98
25.000 mm	77.30
20.000 mm	67.42
16.000 mm	58.76
12.500 mm	50.59
10.000 mm	39.00
6.300 mm	25.36
4.750 mm	21.68
2.360 mm	18.66
1.180 mm	15.80
0.600 mm	13.68
0.425 mm	7.23
0.300 mm	5.68
0.150 mm	0.94
0.075 mm	0.16
0.070 mm	
0.051 mm	
0.037 mm	
0.026 mm	
0.019 mm	
0.014 mm	
0.010 mm	
0.007 mm	
0.005 mm	
0.003 mm	
0.002 mm	
0.001 mm	



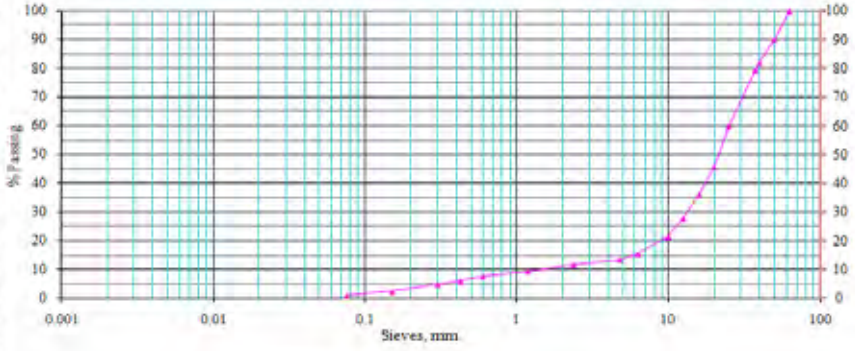
CLAY	SILT	SAND	GRAVEL
0.0 %	0.2 %	21.5 %	78.3 %

GRAIN SIZE ANALYSIS

Test Method : IS: 2720 (Part 4) - 1985
Project : Landslide Monitoring
Location : Sindhuli Road Section II
Client : JICA

Borehole: 1 - B2
Depth: 0.50 m

Sieve	% Passing
75.000 mm	
63.000 mm	100.00
50.000 mm	90.10
40.000 mm	82.07
37.500 mm	79.56
25.000 mm	60.30
20.000 mm	45.55
16.000 mm	36.25
12.500 mm	27.86
10.000 mm	21.48
6.300 mm	13.63
4.750 mm	13.44
2.360 mm	11.73
1.180 mm	9.51
0.600 mm	7.71
0.425 mm	6.14
0.300 mm	5.05
0.150 mm	2.42
0.075 mm	0.86
0.070 mm	
0.051 mm	
0.037 mm	
0.026 mm	
0.019 mm	
0.014 mm	
0.010 mm	
0.007 mm	
0.005 mm	
0.003 mm	
0.002 mm	
0.001 mm	



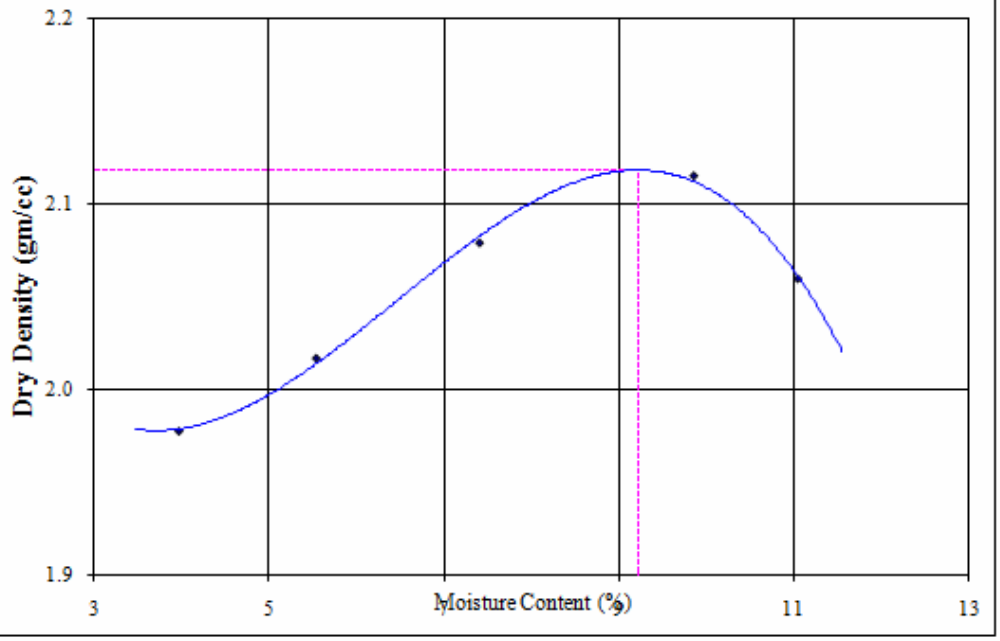
CLAY	SILT	SAND	GRAVEL
0.0 %	0.9 %	12.6 %	86.6 %

JICA STUDY TEAM
SINDHULI RAOD
SECTION II
COMPACTION TEST RESULT

Location : A1

Weight of Hammer	: 4.5 kg.	Height of Drop	: 45 cm
Number of Layers	: 5	Blows per Layer	: 56
Mould Volume :	: 2207.81 cc		

Test Number =>		1	2	3	4	5
Mass of mould + base + compacted specimen	gm	12,390	12,550	12,780	12,980	12,900
Mass of mould + base	gm	7,850	7,850	7,850	7,850	7,850
Mass of compacted specimen	gm	4,540	4,700	4,930	5,130	5,050
Bulk density	gm/cc	2.06	2.13	2.23	2.32	2.29
Moisture content	%	3.97	5.54	7.41	9.86	11.05
Dry density	gm/cc	1.98	2.02	2.08	2.12	2.06



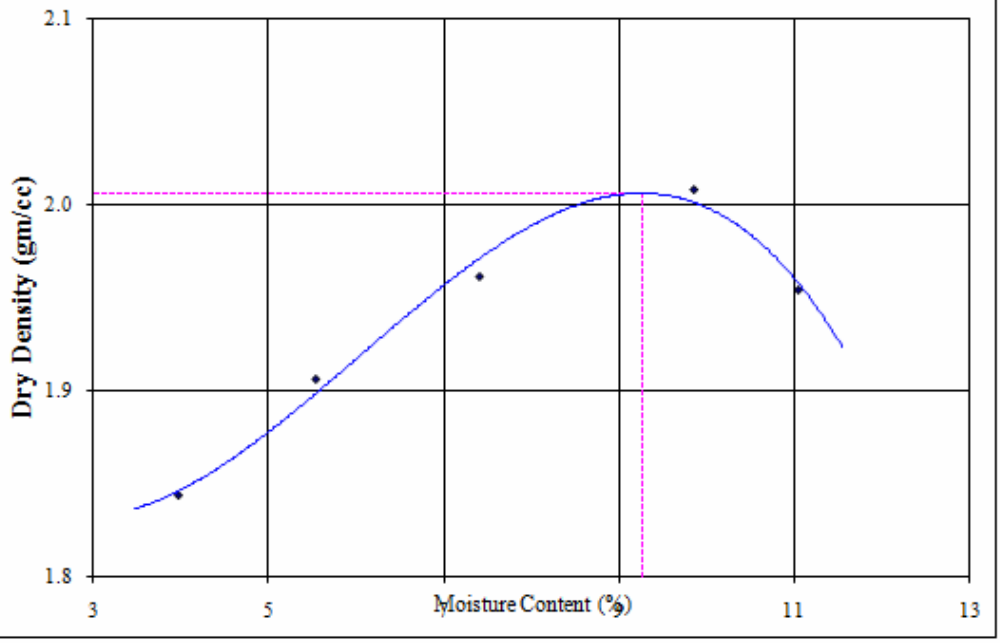
Optimum moisture Content =	**9.2 %**
Maximum Dry Density =	**2.12 gm/cc**

JICA STUDY TEAM
SINDHULI RAOD
SECTION II
COMPACTION TEST RESULT

Location : A2

Weight of Hammer	: 4.5 kg.	Height of Drop	: 45 cm
Number of Layers	: 5	Blows per Layer	: 56
Mould Volume :	: 2207.81 cc		

Test Number =>		1	2	3	4	5
Mass of mould + base + compacted specimen	gm	9,740	9,950	10,160	10,380	10,300
Mass of mould + base	gm	5,508	5,508	5,508	5,508	5,508
Mass of compacted specimen	gm	4,232	4,442	4,652	4,872	4,792
Bulk density	gm/cc	1.92	2.01	2.11	2.21	2.17
Moisture content	%	3.97	5.54	7.41	9.86	11.05
Dry density	gm/cc	1.84	1.91	1.96	2.01	1.95



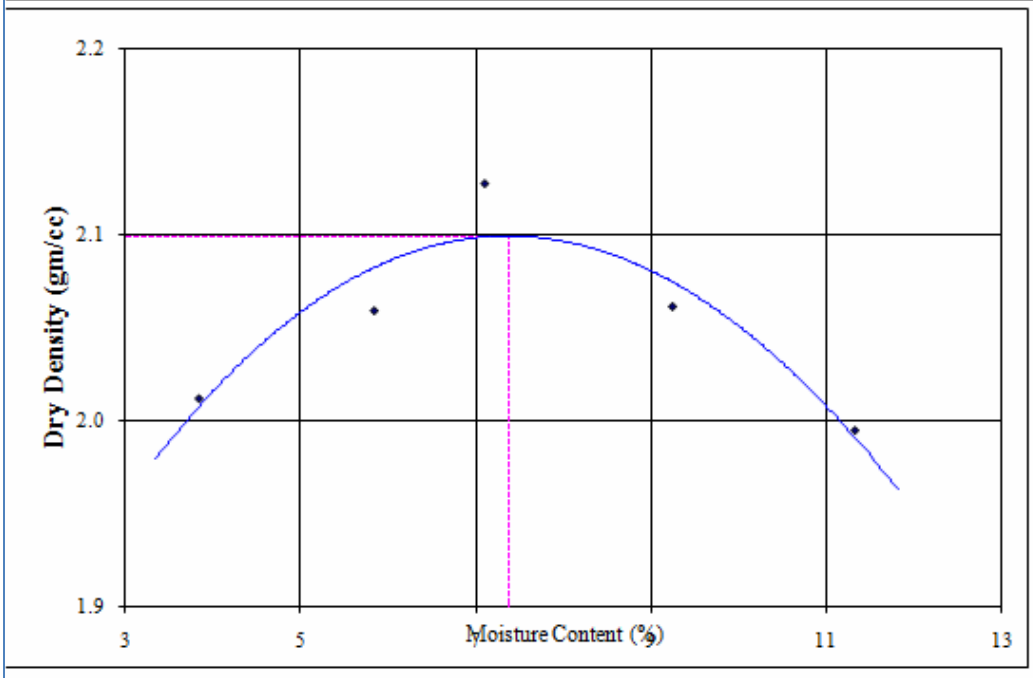
Optimum moisture Content = 9.3 %
Maximum Dry Density = 2.01 gm/cc

JICA STUDY TEAM
SINDHULI RAOD
SECTION II
COMPACTION TEST RESULT

Location : B2

Weight of Hammer	: 4.5 kg.	Height of Drop	: 45 cm
Number of Layers	: 5	Blows per Layer	: 56
Mould Volume :	: 2207.81 cc		

Test Number =>		1	2	3	4	5
Mass of mould + base + compacted specimen	gm	10,120	10,320	10,540	10,480	10,410
Mass of mould + base	gm	5,508	5,508	5,508	5,508	5,508
Mass of compacted specimen	gm	4,612	4,812	5,032	4,972	4,902
Bulk density	gm/cc	2.09	2.18	2.28	2.25	2.22
Moisture content	%	3.84	5.84	7.10	9.24	11.32
Dry density	gm/cc	2.01	2.06	2.13	2.06	1.99



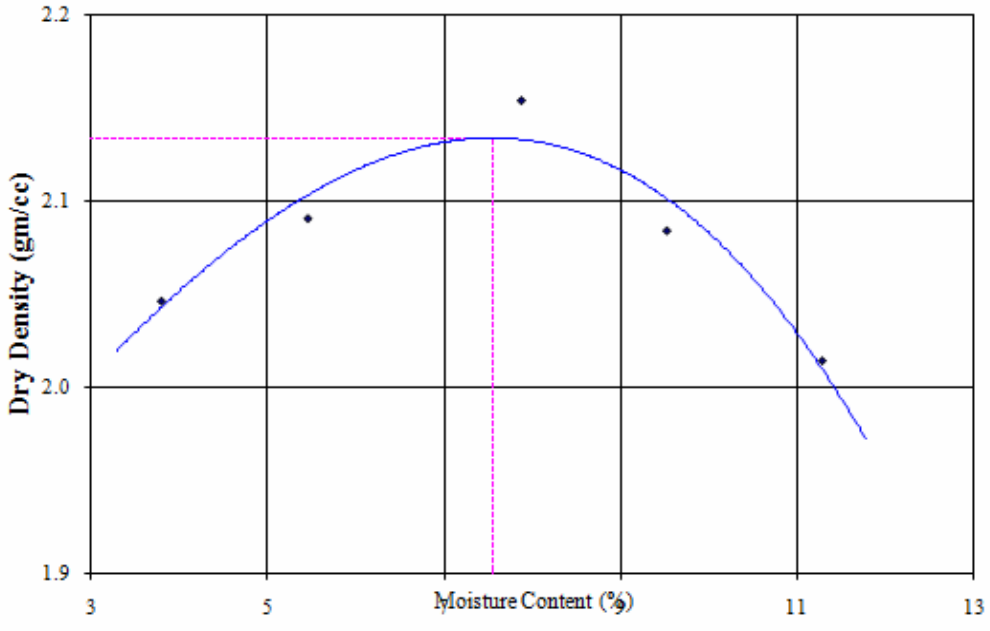
Optimum moisture Content = 7.4 %
Maximum Dry Density = 2.10 gm/cc

JICA STUDY TEAM
SINDHULI RAOD
SECTION II
COMPACTION TEST RESULT

Location : B1

Weight of Hammer	: 4.5 kg.	Height of Drop	: 45 cm
Number of Layers	: 5	Blows per Layer	: 56
Mould Volume :	: 2207.81 cc		

Test Number =>		1	2	3	4	5
Mass of mould + base + compacted specimen	gm	12,540	12,718	12,980	12,890	12,800
Mass of mould + base	gm	7,850	7,850	7,850	7,850	7,850
Mass of compacted specimen	gm	4,690	4,868	5,130	5,040	4,950
Bulk density	gm/cc	2.12	2.20	2.32	2.28	2.24
Moisture content	%	3.79	5.45	7.87	9.52	11.28
Dry density	gm/cc	2.05	2.09	2.15	2.08	2.01



Optimum moisture Content =	**7.5 %**
Maximum Dry Density =	**2.13 gm/cc**

APPENDIX 3 RAINFALL ANALYSIS

Table of Contents

APPENDIX III

RAINFALL ANALYSIS

3.1 Correlation between Disaster Occurrences and Rainfall Intensity

It organized former rainfall data and collapse data and it considered relation between the rainfall and the collapse.

3.1.1 The collection and the organization of the rainfall data

It collected and it organized the data of the STA17+100 rain gage station which is the nearest the site. So far, it was the organization only of the daily rainfall data but to improve precision more, this time, it organized a reading hourly rainfall data which was read in the indicator paper.

Also, because it was observed only in the rainy season, it organized as 0 mm except the observation period. Incidentally, it was included the semiautomatic rainfall gauge data which was established in this study.

Table 3.1.1 The specification of the organized rainfall data

Observation stations	STA17+100	Remarks
Source	Hazama Ando JV	
Data format	paper（1week）	
Observing period	25th Jun2003～31th Oct 26th Apr2004～31th Oct 01th May2005～31th Oct 25thApr2006～31th Oct 27thApr2007～31th Oct 27thApr 2008～31th Oct 27thApr 2009～06thNov 29thJun2010～03thNov	8years observing period in this study

3.1.2 The relation between the rainfall and the collapse.

(1) The method of study

Since the collapse occurs as a trigger by the rain, it is important to clarify the relationship between disasters and more rain down. It is said that if the accumulated rainfall in the slope is over the storage capacity, the collapse occurs.

Therefore, the occurrence of collapse is related to short-term rainfall intensity and long-term rainfall.

It is showed that the sample of the analysis between the rain and the collapse occurrence in figure 3.1.1. It is thought that a long-term rainfall and a short-term rainfall are related to the collapse on this site, so we executed this examination was executed. The simplest, continuous rainfall was adopted this time though various methods were proposed as for the calculation of a long-term rainfall. A continuous rainfall is a rainfall placed between 24 hour no rainfall as shown in figure 3.1.2. Moreover, because the collapse occurrence time was uncertain, maximum rainfall was assumed to be a short-term rainfall.

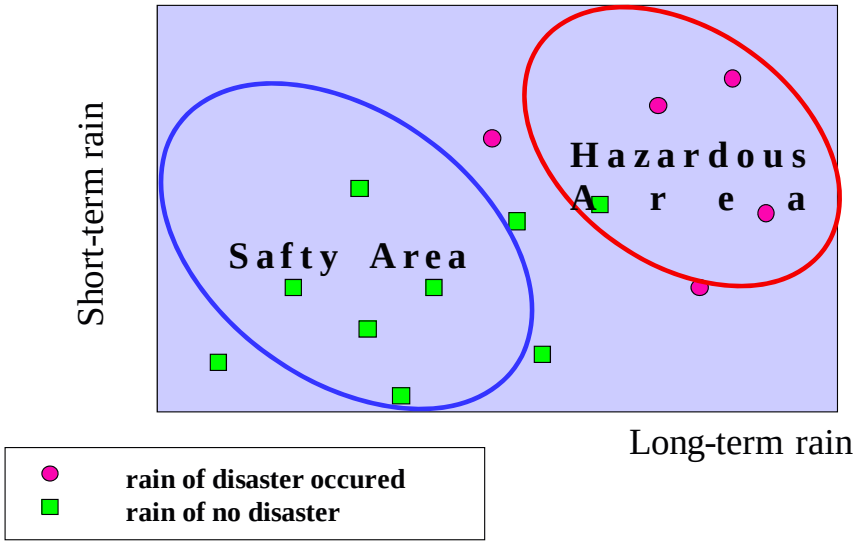
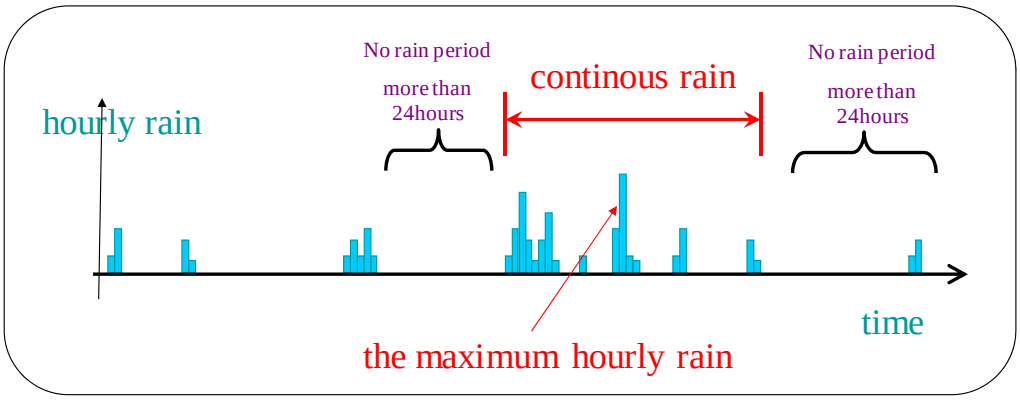


Figure 3.1.1 The Sample of the Analysis between the Rainfall and the Collapse Occurrence.



(Note) It was a continuous rain there is a period of rainfall before and after 24 hours. Also, it dealt only with the rainfall that the continuation rainfall is more than 20 mm.

Figure 3.1.2 Calculation of Continuous Rainfall

(2) The characteristic with rain

The monthly rain is as shown below.

Table 3.1.2 Monthly Rainfall

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	合計
2003						197.5	457.5	291	328.5	44.5	0	0	
2004	0	0	0	36	105.5	207.5	764	216.5	264	129.5	0	0	1,723
2005	0	0	0	0	56	86.5	362.5	746	239.5	142	0	0	1,633
2006	0	0	0	0	323.5	556.5	281.5	243	534.5	26.5	0	0	1,966
2007	0	0	0	59.5	190.5	546	796	465	540	217.5	0	0	2,815
2008	0	0	0	14	205	554.5	540.5	475	339.5	138	0	0	2,267
2009	0	0	0	15	120	87	352.5	295.5					870
2010	0	0	0			15.5	439.5	478	377	74.5			1,385
Average	0	0	0	21	167	281	499	401	375	110	0	0	1,854

Also, the number of days that a rainfall was observed is as shown below.

Table 3.1.3 The list of the number of days that a rainfall was observed

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2003						3	29	27	25	11	0	0
2004	0	0	0	2	12	23	26	22	19	14	0	0
2005	0	0	0	0	11	16	26	29	20	17	0	0
2006	0	0	0	0	17	24	25	18	26	6	0	0
2007	0	0	0	2	10	22	30	26	23	13	0	0
2008	0	0	0	2	22	28	28	27	23	7	0	0
2009	0	0	0	2	13	10	22	14	1	0	0	0
2010	0	0	0	0	1	2	27	26	27			
Average	0	0	0	1	14	18	27	23	20	11	0	0

The distribution of the hourly rainfall and the continuous rainfall is as in Table 3.1.4. The hourly rainfalls more than 50 mm were 4 times in 8 years. Also, the continuous rainfalls of more than 500 mm ware twice in 8 years.

Table 3.1.4 The Distribution of the Hourly Rainfall and the Continuous Rainfall

The hourly rainfall(mm)	times	the continuous rainfall (mm)	times
0	61,244	20-100	94
0-10	2,875	100-200	30
10-20	275	200-300	8
20-30	73	300-400	4
30-40	30	400-500	0
40-50	7	500-600	1
50-60	4	600-700	1

*:The continuous rainfall deals with only more than 20 mm rainfall.

(3) The estimation of the collapse occurrence time

The date which the collapse occurred to is clear but the time which the collapse occurred to is unclear. Therefore, it supposed that the collapse occurred in the end of the continuation rainfall. Also, it was organizing a collapse record in the preceding paragraph. These are the one to have organized the past material and don't always still agree more with the rainfall which was organized this time because the rain gage station, too, was different. The small collapse occurs five times during the in this study.

In this year, it is implementing investigation and the slight collapse can be correctly grasped but such an ordinary year collapse is estimated to occur intermittently.

Table 3.1.5 The Estimated Time of Collapse Occurrence

STA	STA17+400	STA17+600	STA18+200
The collapse record	1 ; 20th Jul2003 at 4h	1 ; 1st Aug at 1h*2	1 ; 20th Jul 2003 at 4h
	2 ; 11th 4Jul11th 2004 at 5h	2 ; 7th Sep7th at 1h	2 ; 11th Jul 2004 at 5h
	3 ; 13th Aug2005 at 18h	3 ; 26th Sep 2007 at 1h*3	3 ; 13th Aug 2005 at 18h
	4 ; 26th Sep 2005 at 23h*1	4 ; 30th Sep 2007 at 1h*3	4 ; 26th Sep 2005 at 23h*1
	5 ; 30th Jul 2007 at 1h*2	5 ; 12th Oct 2007 at 7h	5 ; 30th Jul 2007 at 1h*2
	6 ; 12th Jul 2010 at 0h	6 ; 27th Jul2009 at 23h	6 ; 23th Jul2008 at 9h
	7 ; 24th Aug 2010 at 7h*4		7 ; 13th Aug 2010 at 20h
	8 ; 35th Aug 2010 at 11h*4		8 ; 24th Aug2010 at 17h
	9 ; 27th Aug 2010 at 10h*4		

*1 The continuous rainfall was equal to or less than 20 mm.
*2 It is the same continuous rainfall.
*3 There is a future rainfall of 250 mm from 3th sep to 1th sep.
*4 It is the same continuous rainfall.
*It made applied because there was a record of the collapse expansion in STA17+400, 18+200 in Nov 2003 and in Dec 2007 but there was not rainfall data.

(4) The relation between the rainfall and the collapse.

It made the continuous rainfall and the maximum hourly rain of the rainfall which the collapse generated and the rainfall which the collapse didn't generate figure 3.1.3 in the plot.

In case of the plot, there was a plot, dividing every area of STA17+400, 18+200 and STA17+600, too. Also, a continuous rainfall ranking was shown in Table 3.1.6.

It finds that it is in the tendency which it is easy for the collapse to generate in the hourly rain when the 30 mm continuous rainfall exceeds 150 mm. Specifically, the large collapse occurs when the continuous rainfall exceeds 500 mm. The hourly rain experienced an about 50 mm rainfall eight times but it is only when the continuous rainfall exceeded 500 mm that the collapse occurred. The relation between the hourly rain and the collapse isn't admitted.

The collapse occurs in the small rainfall. This is estimated to be the purpose that the unstable soil mass which was left on the slope reacts to for the slope to become steep with the collapse in the past to the small rainfall and that it is collapsing.

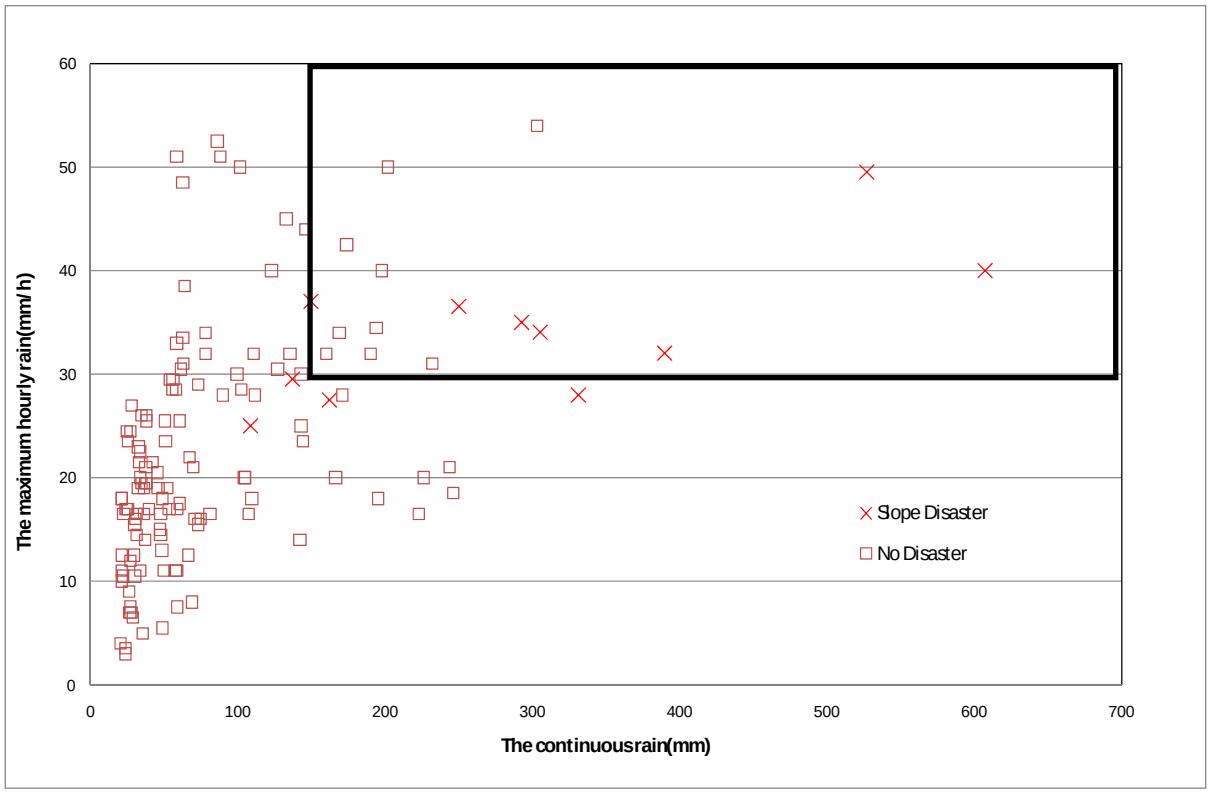


Figure 3.1.3 The relation between the rainfall and the collapse (3 areas)

①Sta.17+400

It finds that it is in the tendency which it is easy for the collapse to generate in the hourly rain exceeds the 30 mm and the continuous rainfall exceeds 150 mm. Specifically, the large collapse occurs when the continuous rainfall exceeds 500 mm. the continuous rainfall about 300mm is observed in every year , so the collapse occurred every year. The hourly rain experienced an about 50 mm rainfall eight times but it is only when the continuous rainfall exceeded 500 mm that the collapse occurred. The relation between the hourly rain and the collapse isn't admitted. After the large collapse in Jul 2004 and Jul 2007, the unstable soil mass which was left on the slope reacts to for the slope to become steep. So this unstable soil mass fail by the small rain.

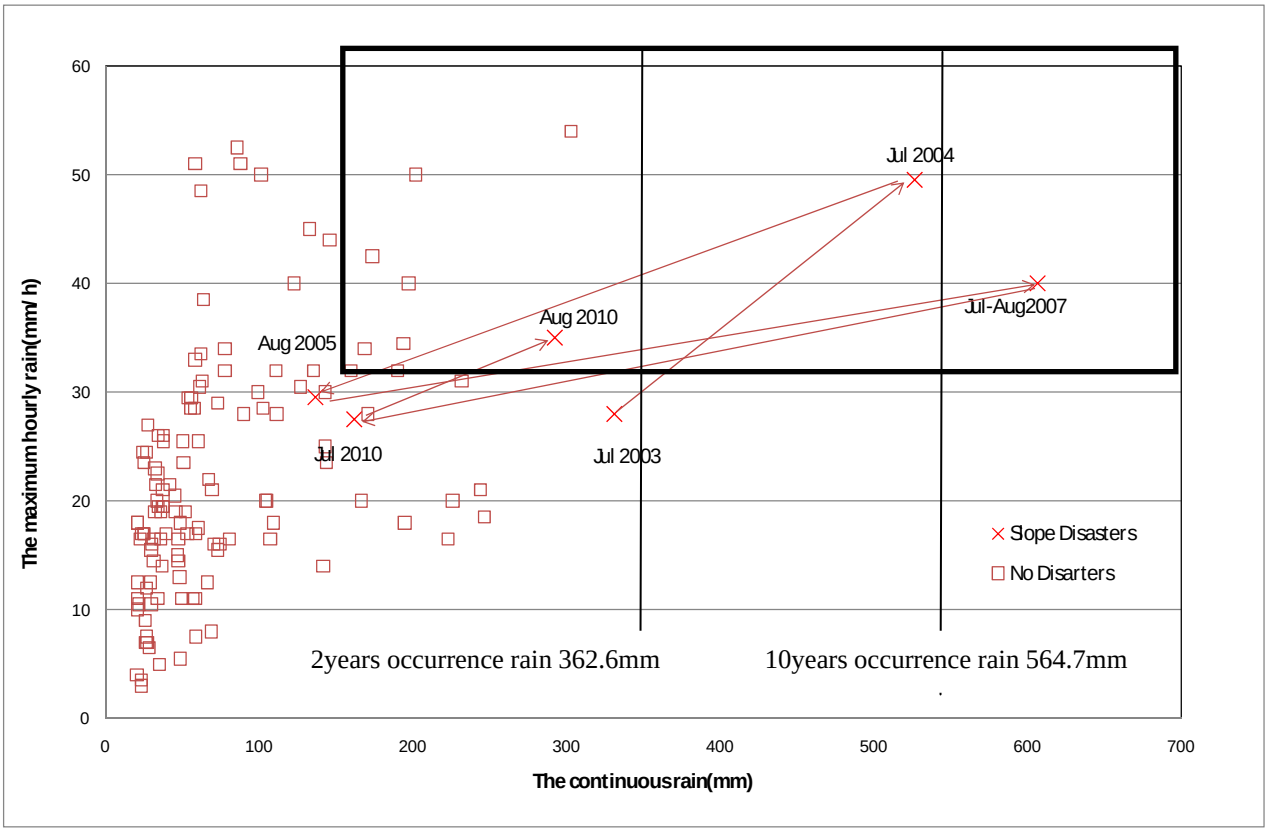


Figure 3.1.4 Correlation between Disaster Occurrences and Rainfall Intensity (Sta.17+400)

②**Sta.17+600**

In Jul-Aug 2007 which was observed the continuous rainfall 607mm, the first large collapse was occurred. After this collapse, small collapses occurred in the continuous rainfall about 150-300mm. The hourly rain experienced an about 50 mm rainfall eight times but the collapse wasn't occurred. The relation between the hourly rain and the collapse isn't admitted. After the large collapse in 2007, the unstable soil mass which was left on the slope reacts to for the slope to become steep. So this unstable soil mass fail by the small rain.

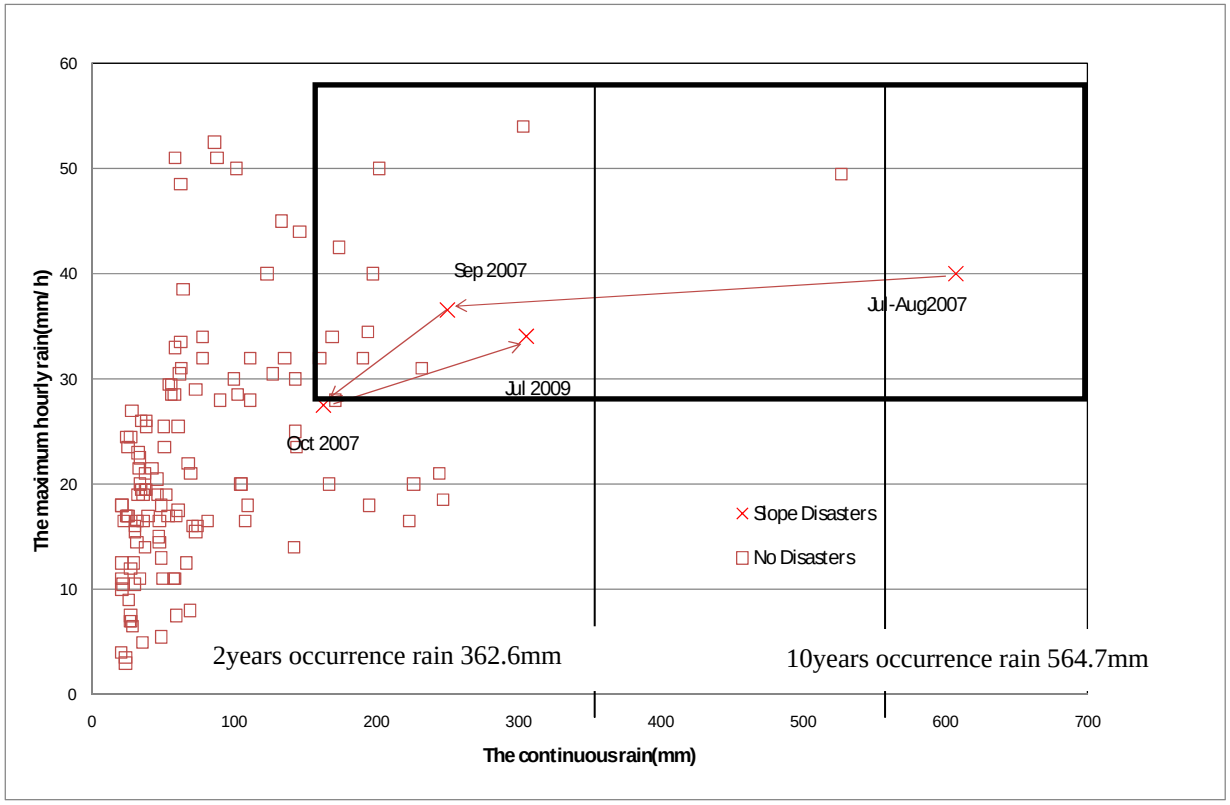


Figure 3.1.5 Correlation between Disaster Occurrences and Rainfall Intensity (Sta.17+600)

③Sta.18+200

It finds that it is in the tendency which it is easy for the collapse to generate in the hourly rain exceeds the 30 mm and the continuous rainfall exceeds 150 mm. Specifically, the large collapse occurs when the continuous rainfall exceeds 500 mm. the continuous rainfall about 300mm is observed in every year , so the collapse occurred every year. The hourly rain experienced an about 50 mm rainfall eight times but it is only when the continuous rainfall exceeded 500 mm that the collapse occurred. The relation between the hourly rain and the collapse isn't admitted. After the large collapse in Jul 2004 and Jul 2007, the unstable soil mass which was left on the slope reacts to for the slope to become steep. So this unstable soil mass fail by the small rain.

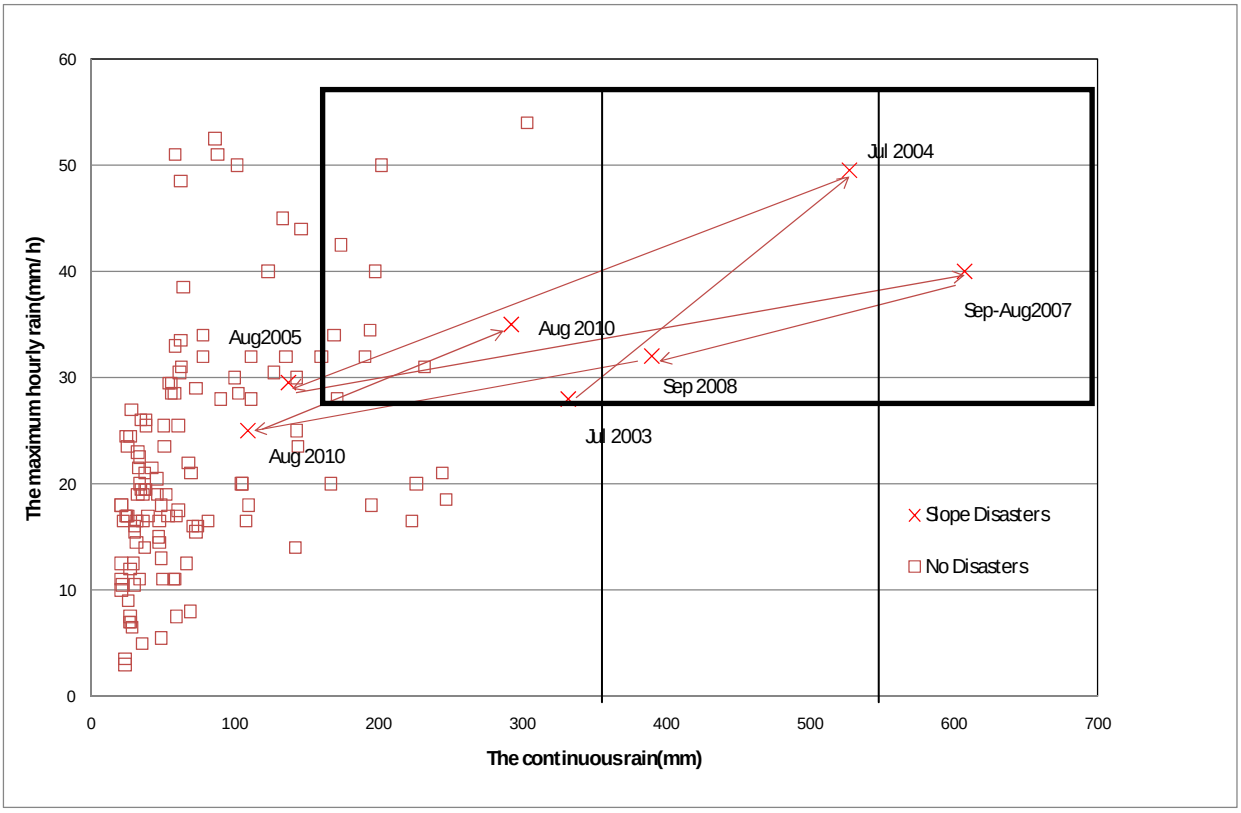


Figure 3.1.6 Correlation between Disaster Occurrences and Rainfall Intensity (Sta.18+200)

Table 3.1.6 The Relation between the Continuous Rainfall Ranking and the Collapse Occurrence（2003-2010）

Order	Year	Order in yaer	Start of rain	Finish of rain	Continuous rain	Site of slope disaster
1	2007	1	18-Jul	2-Aug	607	17+400,17+600,18+200
2	2004	1	4-Jul	12-Jul	527	17+400,18+200
3	2008	1	8-Jul	27-Jul	390	18+200
4	2003	1	6-Jul	20-Jul	331.5	17+400,18+200
5	2009	1	25-Jul	1-Aug	305.5	17+600
6	2006	1	6-Sep	13-Sep	303	
7	2010	1	20-Aug	27-Aug	292.5	17+400,18+200
8	2007	2	3-Sep	11-Sep	250	17+600
9	2005	1	18-Aug	27-Aug	246.5	
10	2007	3	12-Aug	17-Aug	244	
11	2006	2	22-Jun	2-Jul	232	
12	2008	2	22-Jun	2-Jul	226	
13	2005	2	15-Jul	25-Jul	223	
14	2008	3	1-Jun	7-Jun	202	
15	2003	2	25-Jun	28-Jun	197.5	
16	2006	3	6-Jul	20-Jul	195	
17	2003	3	18-Sep	24-Sep	194	
18	2007	4	11-Jun	15-Jun	190.5	
19	2007	5	8-Jul	17-Jul	174	
20	2005	3	5-Aug	7-Aug	171	
21	2005	4	8-Aug	12-Aug	169	
22	2008	4	25-Aug	2-Sep	166.5	
23	2010	2	8-Jul	16-Jul	162.5	17+400
24	2007	6	16-Jun	20-Jun	160	
25	2007	7	8-Oct	12-Oct	149.5	17+600
26	2010	3	20-Jul	25-Jul	146	
27	2010	4	9-Sep	20-Sep	144	
28	2006	4	26-May	29-May	143	
29	2007	8	5-Jun	10-Jun	143	
30	2006	5	20-Sep	26-Sep	142	
31	2005	5	13-Aug	17-Aug	137	17+400,18+200,
32	2008	5	3-Jul	7-Jul	135.5	
33	2008	6	3-Sep	6-Sep	133	
34	2006	6	8-Jun	10-Jun	127	
35	2009	2	3-Aug	7-Aug	123	
36	2008	7	4-Aug	9-Aug	111.5	
37	2004	2	22-Sep	25-Sep	111	
38	2009	3	8-Aug	14-Aug	109.5	
39	2010	5	13-Aug	17-Aug	109	18+200
40	2004	3	15-Jul	20-Jul	107.5	

(5) The probability of rain in study area

The probabilities of rain were calculated from the observed rainfall data. The probability of rain was calculated by hourly rain, daily rain, and continuous rain.

It is showed the probability of daily rainfall stations Sindhuli Gali for reference in the Table 3.1.7.

This probability of rain was calculated by 1956 - 1994 (38 years) data.

Table 3.1.7 The Probability of Rain in Study Area

Occurrence period	continuous rain (mm)	hourly rain (mm)	daily rain (mm)	daily rain (reference) (mm)*1
2	362.6	45	128.6	170
5	481.5	52	167.7	250
10	564.7	56.1	197.1	302
30	697.4	61.7	246.4	369
50	758.9	64.1	270.8	419

*1：Basic design study report on the project for construction of Sindhuli Road (section II : Sindhuli Bazar - Khurkot) in Kingdom of Nepal : final report 1999

The two large collapses have occurred in about 10-years rainfall probability. When heavy rain fell like this in the future that is likely to cause the collapse of a similar scale. The slope became steep by the collapse, which tended to increase gradually collapse.