Republic of Honduras
Alcaldía Municipal del Distrito Central,
Comité Permanente de Contingencias,
Universidad Nacional Autónoma de Honduras

Project for Control and Mitigation of Slope Disasters in the Central District in Republic of Honduras

Project Completion Report Appendix

February 2026

Japan International Cooperation Agency (JICA)

Kokusai Kogyo Co., Ltd.
OYO Corporation

GE
JR
25-111

Appendix 1

Monitoring Sheet Ver.1 to Ver.11

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Version of the Sheet: Ver.01（Term: February, 2019 - March, 2019）

Name: Takeshi Kuwano

Title: Team leader

Submission Date: March 20, 2019

I. Summary

1 Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of March 2019
Japanese Side Experts	Total MM: 54.80 MM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	5.03 MM (9.29 % of Total MM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	0	0	(future activity)
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	0	0	(future activity)
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	0	0	(future activity)
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	0	0	(future activity)
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	0	0	(future activity)
A manual for hazard and risk mapping is prepared.	0	0	(future activity)
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	0	0	(future activity)
Land use regulation maps for slope disasters for pilot special regime zones are created.	0	0	(future activity)

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose:		

Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	0	(future activity)
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	0	(future activity)

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

None.

2-2 Cause

None.

2-3 Action to be taken

None.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

(Remarks: The amendment of R/D and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, and input) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D and PDM, the team may propose the draft.)

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1] Version: 1.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH) Dated: March 20, 2019
Project Period: 2018 to 2021 (about 3 years and 9 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high.	(future activity)	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		(future activity)	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

			• AMDC has access to the equipment and tools owned by UNAH.		
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced. • A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	(future activity) (future activity)	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. • A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		(future activity) (future activity)	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created. • A manual for hazard and risk mapping is prepared.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		(future activity) (future activity)	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created. • Land use regulation maps for slope disasters for pilot special regime zones are created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		(future activity) (future activity)	

Activities	**Input**	**Pre-condition**
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 1 large-size landslide and 1 large-size slope failure/rock fall) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Input: Japanese Side 1. Experts 1) Team leader	Working members are assigned.

1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.		**<u>Issues and Countermeasures</u>**

3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMRET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 1
Dated: March 20, 2019

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	Remarks	Monitoring: Issue	Monitoring: Solution
		1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12			
Expert								
Team leader / Slope disaster risk analysis	Plan						No issue.	
	Actual							
Geological investigation and analysis (Landslide)	Plan							
	Actual							
Structural measures (Landslide)	Plan							
	Actual							
Structural measures (Slope failure and Rockfall)	Plan							
	Actual							
Geological investigation and analysis (Slope failure and rockfall)	Plan							
	Actual							
Topographic survey	Plan							
	Actual							
Slope disaster hazard evaluation	Plan							
	Actual							
GIS Mapping	Plan							
	Actual							
Land use regulation	Plan							
	Actual							
Project coordinator/ Training plan	Plan							
	Actual							
Equipment								
Equipement	Plan						No issue.	
	Actual							
Training in Japan								
Traning in japan	Plan						(future activity)	
	Actual							
In-country/Third country Training								
	Plan							
	Actual							

Activities / Sub-Activities	Year	2019	2020	2021	2022	Responsible Organization: Japan	Responsible Organization: GoH	Achievements	Issue & Countermeasures
		1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12				
Output 1:									
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 1 large-size landslide and 1 large-size slope failure/rock fall) to implement structural measures on slope disasters.	Plan							6 pilot sites have been identified and selected.	
	Actual								
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan							Work Plan is being prepared.	
	Actual								
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan							(future activity)	The drone survey may be canceled because the device is not prepared.
	Actual								
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan							(future activity)	
	Actual								
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan							(future activity)	
	Actual								
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan							(future activity)	
	Actual								
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan							(future activity)	
	Actual								
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan							(future activity)	
	Actual								
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan							(future activity)	
	Actual								
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan							(future activity)	
	Actual								
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan							(future activity)	
	Actual								
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan							(future activity)	
	Actual								
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan							(future activity)	
	Actual								
Output 2:									
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan							(future activity)	
	Actual								
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan							(future activity)	
	Actual								
2.3.Conduct the environmental impact/social assessment.	Plan							(future activity)	
	Actual								
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan							(future activity)	
	Actual								
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan							(future activity)	
	Actual								
2.6. Conduct bidding and award process	Plan							(future activity)	
	Actual								
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan							(future activity)	
	Actual								
2.8. Implement and supervise structural measure works.	Plan							(future activity)	
	Actual								
2.9. Prepare a monitoring and maintenance plan.	Plan							(future activity)	
	Actual								
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan							(future activity)	
	Actual								
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan							(future activity)	
	Actual								

2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan	(future activity)	
	Actual		
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan	(future activity)	
	Actual		
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan	The review of maps and information was started.	
	Actual		
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan	(future activity)	
	Actual		
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan	(future activity)	
	Actual		
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan	(future activity)	
	Actual		
3.5. Collect the existing geo-spatial data in the pilot area.	Plan	(future activity)	
	Actual		
3.6. Analyze the geo-spatial data in the pilot area.	Plan	(future activity)	
	Actual		
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan	(future activity)	
	Actual		
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan	(future activity)	
	Actual		
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMRET based on the prioritization in activity 3.8	Plan	(future activity)	
	Actual		
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan	(future activity)	
	Actual		
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan	(future activity)	
	Actual		
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan	(future activity)	
	Actual		
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan	The review of the current approach and information was started.	
	Actual		
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan	(future activity)	
	Actual		
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan	(future activity)	
	Actual		
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan	(future activity)	
	Actual		
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan	(future activity)	
	Actual		
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan	(future activity)	
	Actual		
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan	(future activity)	
	Actual		
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan	(future activity)	
	Actual		
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan	(future activity)	
	Actual		
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan	(future activity)	
	Actual		
Duration / Phasing	Plan		
	Actual		

Monitoring Plan	Year	2019												2020												2021												2022												Remarks	Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12			
Monitoring																																																			
Joint Coordinating Committee	Plan																																																		
	Actual																																																		
Submission of Monitoring Sheet	Plan																																																		
	Actual																																																		
Reports/Documents																																																		
Work Plan	Plan																																																	
	Actual																																																	
Progress Report	Plan																																																	
	Actual																																																	
Final Report	Plan																																																	
	Actual																																																	
Public Relations																																																		
	Plan																																																		
	Actual																																																		
	Plan																																																		
	Actual																																																		

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Version of the Sheet: Ver.02（Term: February, 2019 – September, 2019）

Name: Takeshi Kuwano

Title: Team leader

Submission Date: September 9, 2019

I. Summary

1 Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of September 2019
Japanese Side Experts	Total MM: 54.80 MM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	8.85 MM (16.14 % of Total MM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	15	10	Detailed investigation was started, and the analysis is being conducted. The start of work was delayed due to the change in contract system in Honduras.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	0	0	(future activity)
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	0	0	(future activity)
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	0	0	(future activity)
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	10	10	Information for the Maps has been gathered.
A manual for hazard and risk mapping is prepared.	0	0	(future activity)
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	5	5	Information for the land use regulation is being gathered.
Land use regulation maps for slope disasters for pilot special regime zones are created.	0	0	(future activity)

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose:		

Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	0	(future activity)
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	0	(future activity)

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

None.

2-2 Cause

None.

2-3 Action to be taken

None.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

(Remarks: The amendment of R/D and PDM (title of the project, duration, project site(s), target group(s), implementation structure, overall goal, project purpose, outputs, activities, and input) should be authorized by JICA HDQs. If the project team deems it necessary to modify any part of R/D and PDM, the team may propose the draft.)

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Project Period: 2018 to 2021 (about 3 years and 9 months)
Project Site: The Central District

Version: 2.0
Dated: September 9, 2019

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high.	(future activity)	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		(future activity)	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

			• AMDC has access to the equipment and tools owned by UNAH.		
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced. • A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	Detailed investigation was started, and the analysis is being conducted. (future activity)	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. • A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		(future activity) (future activity)	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created. • A manual for hazard and risk mapping is prepared.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		Information for the Maps has been gathered. (future activity)	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created. • Land use regulation maps for slope disasters for pilot special regime zones are created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		Information for the land use regulation is being gathered. (future activity)	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Input: Japanese Side 1. Experts 1) Team leader	Working members are assigned.

1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.		**<u>Issues and Countermeasures</u>**

3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 2
Dated: September 9, 2019

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019												2020												2021												2022												Remarks	Monitoring: Issue	Monitoring: Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12			
Expert																																																		
Team leader / Slope disaster risk analysis	Plan																																																	
	Actual																																																	
Geological investigation and analysis (Landslide)	Plan																																																	
	Actual																																																	
Structural measures (Landslide)	Plan																																																	
	Actual																																																	
Structural measures (Slope failure and Rockfall)	Plan																																																	
	Actual																																																	
Geological investigation and analysis (Slope failure and rockfall)	Plan																																																	
	Actual																																																	
Topographic survey	Plan																																																	
	Actual																																																	
Slope disaster hazard evaluation	Plan																																																	
	Actual																																																	
GIS Mapping	Plan																																																	
	Actual																																																	
Land use regulation	Plan																																																	
	Actual																																																	
Project coordinator/ Training plan	Plan																																																	
	Actual																																																	
Equipment																																																	
Equipement	Plan																																																	
	Actual																																																	
Training in Japan																																																	
Traning in japan	Plan																																																	
	Actual																																																	
In-country/Third country Training																																																	
	Plan																																																	
	Actual																																																	

Activities / Sub-Activities	Year	2019												2020												2021												2022												Responsible Organization: Japan	Responsible Organization: GoH	Achievements	Issue & Countermeasures
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12				
Output 1:																																																			
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan																																																		
	Actual																																																		
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan																																																	
	Actual																																																	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan																																																	
	Actual																																																	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan																																																	
	Actual																																																	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan																																																	
	Actual																																																	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan																																																	
	Actual																																																	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan																																																	
	Actual																																																	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan																																																	
	Actual																																																	
Output 2:																																																		
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan																																																	
	Actual																																																	
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan																																																	
	Actual																																																	
2.3.Conduct the environmental impact/social assessment.	Plan																																																	
	Actual																																																	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan																																																	
	Actual																																																	
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan																																																	
	Actual																																																	
2.6. Conduct bidding and award process	Plan																																																	
	Actual																																																	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan																																																	
	Actual																																																	
2.8. Implement and supervise structural measure works.	Plan																																																	
	Actual																																																	
2.9. Prepare a monitoring and maintenance plan.	Plan																																																	
	Actual																																																	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan																																																	
	Actual																																																	
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan																																																	
	Actual																																																	

	Monitoring: Issue	Monitoring: Solution
Expert	No issue.	
Equipment	No issue.	
Training in Japan	(future activity)	
In-country/Third country Training		
Output 1: 1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	6 pilot sites have been identified and selected.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Work Plan is being prepared.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	The site work has been done in 2 site. The contour map and longitudinal section is being prepared.	The start of work was delayed due to the change in contract system in Honduras.
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Drilling survey was started and Laboratory test and Electrical Resistivity Survey have been done.	The start of work was delayed due to the change in contract system in Honduras.
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	(future activity)	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	(future activity)	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	(future activity)	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	(future activity)	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	(future activity)	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	(future activity)	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	(future activity)	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Seminar on Geological survey and analysis was held.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	(future activity)	
Output 2: 2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	(future activity)	
2.2.Organize applicability of structural measure methods for different slope disasters.	(future activity)	
2.3.Conduct the environmental impact/social assessment.	(future activity)	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	(future activity)	
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	(future activity)	
2.6. Conduct bidding and award process	(future activity)	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	(future activity)	
2.8. Implement and supervise structural measure works.	(future activity)	
2.9. Prepare a monitoring and maintenance plan.	(future activity)	
2.10. Conduct monitoring and maintenance of the structural measure works.	(future activity)	
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	(future activity)	

2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan		(future activity)
	Actual		
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan		(future activity)
	Actual		
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan		The review of maps and information has been done.
	Actual		
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan		The pilot sites have been identified and selected.
	Actual		
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan		The check sheets for simple hazard/risk evaluation have been prepared.
	Actual		
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan		(future activity)
	Actual		
3.5. Collect the existing geo-spatial data in the pilot area.	Plan		The existing geo-spatial data in the pilot area has been collected.
	Actual		
3.6. Analyze the geo-spatial data in the pilot area.	Plan		The geo-spatial data in the pilot area is being analyzed.
	Actual		
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan		(future activity)
	Actual		
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan		(future activity)
	Actual		
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan		(future activity)
	Actual		
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan		(future activity)
	Actual		
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan		Seminars on hazard/risk evaluation and GIS mapping were conducted.
	Actual		
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan		(future activity)
	Actual		
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan		The review of the current approach and information is being continued.
	Actual		
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan		Community survey was carried out and the result was summarized.
	Actual		
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan		(future activity)
	Actual		
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan		(future activity)
	Actual		
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan		(future activity)
	Actual		
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan		(future activity)
	Actual		
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan		(future activity)
	Actual		
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan		(future activity)
	Actual		
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan		Current situation on land use regulation in Japan was explained through seminar.
	Actual		
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan		(future activity)
	Actual		

Duration / Phasing	Plan		
	Actual		

Monitoring Plan	Year	2019												2020												2021												2022												Remarks	Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12			
Monitoring																																																			
Joint Coordinating Committee	Plan																																																		
	Actual																																																		No issue.	
Submission of Monitoring Sheet	Plan																																																		
	Actual																																																		No issue.	
Reports/Documents																																																			
Work Plan	Plan																																																		
	Actual																																																		No issue.	
Progress Report	Plan																																																		
	Actual																																																		No issue.	
Final Report	Plan																																																	
	Actual																																																		No issue.	
Public Relations																																																		
	Plan																																																		
	Actual																																																		
	Plan																																																		
	Actual																																																		

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Version of the Sheet: Ver.03（Term: September 2019 – June 2021）

Name: Takeshi Kuwano

Title: Team leader

Submission Date: June 21, 2020

I. Summary

1 Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of May 2021
Japanese Side Experts	Total MM: 54.80 MM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	30.81 MM (47.70 % of Total MM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	85	85	Detailed investigation and analysis by JICA Project were completed, and summarized as Progress Report 1. Those by C/P are being conducted.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	0	0	(future activity)
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	60	60	The design of 2 structural measures by JICA Project were almost completed. Those by C/P are started.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	0	0	(future activity)
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	70	70	Site investigation for making the maps was completed. Method to evaluate the hazard and risk is being discussed.
A manual for hazard and risk mapping is prepared.	0	0	(future activity)
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	50	50	The land use regulation and the targets are being discussed regularly in the Working Group.
Land use regulation maps for slope disasters for pilot special regime zones are created.	0	0	(future activity)

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose:		

Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	10	2 pilot structural measures are being planned for budget request in 2022 by AMDC.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	0	(future activity)

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

The pandemic of COVID19 has almost suspended the activities in the Project from March 2020 to May 2021.

2-2 Cause

The pandemic of COVID19.

2-3 Action to be taken

The period of the Project was discussed by JICA and C/P to achieve the Project Purpose and Output. The Plan of Operation is modified as mentioned in "3-1 PO."

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

The period of the Project is extended for 1 year as follows;

Original period: February 2019 to December 2022.

Modified period: February 2019 to December 2023.

3-2 Other modifications on detailed implementation plan

According to the modification of the schedule, the construction of countermeasure works is implemented in the 4 pilot sites as follows;

Campo Cielo and Fuerzas Unidas: November 2021 to April 2022.

Nueva Santa Rosa and Villa Nueva: November 2022 to April 2023.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1] Version: 3.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH) Dated: June 21, 2021
Project Period: 2019 to 2024 (about 4 years and 9 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high.	2 pilot structural measures are being planned for budget request in 2022 by AMDC.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		(future activity)	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

			• AMDC has access to the equipment and tools owned by UNAH.		
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	Detailed investigation and analysis by JICA Project were completed, and summarized as Progress Report 1. Those by C/P are being conducted.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			(future activity)	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		The design of 2 structural measures by JICA Project are almost completed. Those by C/P are started.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			(future activity)	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		Site investigation for making the maps was completed. Method to evaluate the hazard and risk is being discussed.	
	• A manual for hazard and risk mapping is prepared.			(future activity)	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation and the targets are being discussed regularly in the Working Group.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.			(future activity)	

Activities	**Input**	**Pre-condition**

1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	Working members are assigned.
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.		**<u>Issues and Countermeasures</u>**

3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 3

Dated: June 21, 2021

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	Monitoring: Issue	Monitoring: Solution
Expert							The activities in the Project have been almost suspended since March 2020 to May 2021 because of the pandemic of COVID19.	The period of the Project should be extended for 1 year. The assignment schedule of the experts was adjusted with the revised schedule of the Project.
Team leader / Slope disaster risk analysis	Plan / Actual							
Geological investigation and analysis (Landslide)	Plan / Actual							
Structural measures (Landslide)	Plan / Actual							
Structural measures (Slope failure and Rockfall)	Plan / Actual							
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual							
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual							
Topographic survey	Plan / Actual							
Slope disaster hazard evaluation	Plan / Actual							
GIS Mapping	Plan / Actual							
Land use regulation	Plan / Actual							
Land use regulation 1	Plan / Actual							
Land use regulation 2	Plan / Actual							
Project coordinator/ Training plan	Plan / Actual							
Equipment								
Equipement	Plan / Actual						No issue.	
Training in Japan								The trainings in Japan in 2020 were shifted to 2021 and 2022.
Traning in japan	Plan / Actual							

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	Achievements	Issue & Countermeasures
Output 1:								
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual						Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual						Completed.	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						Completed. The monitoring is being continued in the landslide sites.	
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual						(future activity)	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual						(future activity)	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual						Seminars on Geological survey and analysis were held.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual						(future activity)	
Output 2:								
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual						(future activity)	
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual						(future activity)	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual						(future activity)	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual						(future activity)	
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual						(future activity)	
2.6. Conduct bidding and award process	Plan / Actual						(future activity)	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual						(future activity)	
2.8. Implement and supervise structural measure works.	Plan / Actual						(future activity)	
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual						(future activity)	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual						(future activity)	
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan / Actual						(future activity)	

2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan		(future activity)
	Actual		
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan		(future activity)
	Actual		
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan		Completed.
	Actual		
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan		Completed.
	Actual		
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan		Completed.
	Actual		
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan		Completed.
	Actual		
3.5. Collect the existing geo-spatial data in the pilot area.	Plan		Completed.
	Actual		
3.6. Analyze the geo-spatial data in the pilot area.	Plan		Completed.
	Actual		
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan		Completed.
	Actual		
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan		Method to evaluate the hazard and risk is being discussed.
	Actual		
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan		The maps in the pilot area in SIMET are being updated.
	Actual		
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan		(future activity)
	Actual		
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan		Seminars on hazard/risk evaluation and GIS mapping were conducted.
	Actual		
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan		(future activity)
	Actual		
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan		Completed.
	Actual		
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan		Completed.
	Actual		
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan		Completed.
	Actual		
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan		The preparation of the technical materials was started.
	Actual		
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan		The land use regulation and the targets are being discussed regularly in the Working Group.
	Actual		
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan		(future activity)
	Actual		
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan		(future activity)
	Actual		
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan		(future activity)
	Actual		
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan		Seminars on examples in Japan were conducted.
	Actual		
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan		(future activity)
	Actual		

Monitoring Plan	Year	2019												2020												2021						2022												2023												Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Monitoring																																																							
Joint Coordinating Committee	Plan																																																					
	Actual																																																					
Submission of Monitoring Sheet	Plan																																																				
	Actual																																																				
Reports/Documents																																																				
Work Plan	Plan																																																			
	Actual																																																			
Progress Report	Plan																																																			
	Actual																																																			
Final Report	Plan																																																			
	Actual																																																			

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.04（Term: July 2021 – January 2022）

Name: Kuwano Takeshi
Title: Team leader
Submission Date: January 31, 2022

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of January 2022
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	42.07 PM (65.13 % of Total PM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	90	90	Detailed investigation and analysis by JICA Project were completed, and summarized as Progress Report 1 and 2. Those by C/P are being conducted.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	5	5	Contents is being discussed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	65	65	2 structural measures by JICA Project are being constructed. Those by C/P are investigated.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	0	0	(future activity)
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	70	70	Site investigation for making the maps was completed. Method to evaluate the hazard and risk is being discussed.
A manual for hazard and risk mapping is prepared.	0	0	(future activity)
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	60	60	The land use regulation and the targets are being discussed regularly in the Working Group.
Land use regulation maps for slope disasters for pilot special regime zones are created.	0	0	(future activity)

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose:		

Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	15	The budget in 2022 for 2 pilot structural measures was requested by AMDC.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	0	(future activity)

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

None.

2-2 Cause

None.

2-3 Action to be taken

None.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1] Version: 4.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH) Dated: January 31, 2022
Project Period: 2019 to 2023 (about 4 years and 9 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high.	The budget in 2022 for 2 pilot structural measures was requested by AMDC.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		(future activity)	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

			• AMDC has access to the equipment and tools owned by UNAH.		
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	Detailed investigation and analysis by JICA Project were completed, and summarized as Progress Report 1 and 2. Those by C/P are being conducted.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			Contents is being discussed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		2 structural measures by JICA Project are being constructed. Those by C/P are investigated.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			(future activity)	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		Site investigation for making the maps was completed. Method to evaluate the hazard and risk is being discussed.	
	• A manual for hazard and risk mapping is prepared.			(future activity)	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation and the targets are being discussed regularly in the Working Group.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.			(future activity)	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	Working members are assigned.
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.		**<u>Issues and Countermeasures</u>**

3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 4

Dated: January 31, 2022

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	Monitoring: Issue	Monitoring: Solution
Expert							No issue.	
Team leader / Slope disaster risk analysis	Plan / Actual							
Geological investigation and analysis (Landslide)	Plan / Actual							
Structural measures (Landslide)	Plan / Actual							
Structural measures (Slope failure and Rockfall)	Plan / Actual							
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual							
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual							
Topographic survey	Plan / Actual							
Construction Planning/Bid Supervision	Plan / Actual							
Construction Supervision	Plan / Actual							
Slope disaster hazard evaluation	Plan / Actual							
GIS Mapping	Plan / Actual							
Land use regulation	Plan / Actual							
Land use regulation 1	Plan / Actual							
Land use regulation 2	Plan / Actual							
Project coordinator/ Training plan	Plan / Actual							
Equipment							Additional equipment was delivered.	
Equipement	Plan / Actual							
Training in Japan								The trainings in Japan in 2020 were shifted to 2022.
Traning in japan	Plan / Actual							

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	Achievements	Issue & Countermeasures
Output 1:								
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual						Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual						Completed.	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						Completed. The monitoring is being continued in the landslide sites.	
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual						The 2 pilot sites by JICA Project have been completed. Those by C/P are being conducted.	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual						The sites were investigated.Draft proposal is being discussed.	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual						Contents is being discussed.	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual						No activity	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual						Contents is being discussed.	
Output 2:								
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual						2 structural measures by JICA Project have been designed. Those by C/P are investigated.	
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual						No issue	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual						The land acquisition in Campo Cielo at the Municipal Cooperation is suspended.	The procedure is needed to discuss at the Municipal Cooperation by the new government after February 2022
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual						The AMDC has requested a budget of Lps 10 million for Villa Nueva and Nueva Santa Rosa	It should be approved at the Municipal Cooperation by the new government after February 2022
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual						The 2 pilot sites by JICA Project have been completed.	
2.6. Conduct bidding and award process	Plan / Actual						The 2 pilot sites by JICA Project have been completed.	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual						The 2 pilot sites by JICA Project have been completed.	
2.8. Implement and supervise structural measure works.	Plan / Actual						Supervision plan is being discussed.	
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual						(future activity)	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual						(future activity)	

2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan Actual	(future activity)	
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan Actual	Seminars on design and construction were conducted.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual	Contents is being discussed.	
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan Actual	Completed.	
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan Actual	Completed.	
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan Actual	Completed.	
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan Actual	Completed.	
3.5. Collect the existing geo-spatial data in the pilot area.	Plan Actual	Completed.	
3.6. Analyze the geo-spatial data in the pilot area.	Plan Actual	Completed.	
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan Actual	Completed.	
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan Actual	Method to evaluate the hazard and risk is being discussed.	
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan Actual	No issue.	
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan Actual	(future activity)	
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan Actual	Seminars on hazard/risk evaluation and GIS mapping were conducted.	
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan Actual	(future activity)	
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan Actual	Completed.	
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan Actual	Completed.	
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan Actual	Completed.	
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan Actual	No issue.	
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan Actual	The land use regulation and the targets are being discussed regularly in the Working Group.	
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan Actual	(future activity)	
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan Actual	(future activity)	
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan Actual	(future activity)	
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan Actual	No issue.	
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual	(future activity)	

Monitoring Plan	Year	2019												2020												2021												2022												2023												Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Monitoring																																																																					
Joint Coordinating Committee	Plan																																																																			
	Actual																																																																					
Submission of Monitoring Sheet	Plan																																																																		
	Actual																																																																					
Reports/Documents																																																																		
Work Plan	Plan																																																																	
	Actual																																																																			
Progress Report	Plan																																																																
	Actual																																																																		
Final Report	Plan																																																																
	Actual																																																																		

Issue: No issue.

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.05（Term: February 2022 – August 2022）

Name: Kuwano Takeshi
Title: Team leader
Submission Date: September 13, 2022

I. Summary

1 Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of August 2022
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	51.94 PM (80.41 % of Total PM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	95	95	All investigation and analysis except the vulnerability evaluation have been completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	5	5	Table of contents was decided. It is being prepared.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	75	75	2 structural measures by JICA Project were completed. Those by C/P are designed.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	5	5	Table of contents was decided. It is being prepared.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	80	80	The risk level has been discussed. The methodology of creating a risk map was defined.
A manual for hazard and risk mapping is prepared.	5	5	Table of contents was decided. It is being prepared.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	70	70	The land use regulation and the maps are being drafted. The draft regulation was submitted to the legal department in AMDC.
Land use regulation maps for slope disasters for pilot special regime zones are created.	10	10	Table of contents was decided. It is being prepared.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose:		

Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	25	The budget, Lp18,000,000 for 2 pilot structural measures was secured by AMDC. 2 structural measures by C/P are designed.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	5	Table of contents for each Output was decided. It is being prepared.

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

None.

2-2 Cause

None.

2-3 Action to be taken

None.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1] Version: 5.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH) Dated: September 13, 2022
Project Period: 2019 to 2023 (about 4 years and 9 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high.	The budget for 2 pilot structural measures was secured by AMDC. 2 structural measures by C/P are designed.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Table of contents for each Output was decided. It is being prepared.	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

			• AMDC has access to the equipment and tools owned by UNAH.		
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	All investigation and analysis except the vulnerability evaluation have been completed.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			Table of contents was decided. It is being prepared.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		2 structural measures by JICA Project were completed. Those by C/P are designed.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			Table of contents was decided. It is being prepared.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		The risk level has been discussed. The methodology of creating a risk map was defined.	
	• A manual for hazard and risk mapping is prepared.			Table of contents was decided. It is being prepared.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation and the maps are being drafted. The draft regulation was submitted to the legal department in AMDC.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.			Table of contents was decided. It is being prepared.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	Working members are assigned.
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.		**<u>Issues and Countermeasures</u>**

3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 5

Dated: September 13, 2022

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019												2020												2021												2022												2023												Monitoring: Issue	Monitoring: Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Expert																																																															
Team leader / Slope disaster risk analysis	Plan																																																												
	Actual																																																												
Geological investigation and analysis (Landslide)	Plan																																																											
	Actual																																																											
Structural measures (Landslide)	Plan																																																											
	Actual																																																											
Structural measures (Slope failure and Rockfall)	Plan																																																										
	Actual																																																											
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan																																																										
	Actual																																																											
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan																																																										
	Actual																																																											
Topographic survey	Plan																																																										
	Actual																																																											
Construction Planning/Bid Supervision	Plan																																																										
	Actual																																																											
Construction Supervision	Plan																																																										
	Actual																																																											
Slope disaster hazard evaluation	Plan																																																										
	Actual																																																											
GIS Mapping	Plan																																																										
	Actual																																																											
Land use regulation	Plan																																																										
	Actual																																																											
Land use regulation 1	Plan																																																										
	Actual																																																											
Land use regulation 2	Plan																																																										
	Actual																																																											
Project coordinator/ Training plan	Plan																																																										
	Actual																																																											
Equipment																																																											
Equipement	Plan																																																										
	Actual																																																											
Training in Japan																																																											
Traning in japan	Plan																																																										
	Actual																																																											

Activities / Sub-Activities	Year	2019												2020												2021												2022												2023												Achievements	Issue & Countermeasures
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Output 1:																																																												
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan																																																											
	Actual																																																												
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																												
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan																																																											
	Actual																																																												
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan																																																										
	Actual																																																											
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan																																																										
	Actual																																																											
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan																																																										
	Actual																																																											
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan																																																										
	Actual																																																											
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan																																																										
	Actual																																																											
Output 2:																																																											
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan																																																										
	Actual																																																											
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan																																																										
	Actual																																																											
2.3.Conduct the environmental impact/social assessment.	Plan																																																										
	Actual																																																											
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan																																																										
	Actual																																																											
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan																																																										
	Actual																																																											
2.6. Conduct bidding and award process	Plan																																																										
	Actual																																																											
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan																																																										
	Actual																																																											
2.8. Implement and supervise structural measure works.	Plan																																																										
	Actual																																																											
2.9. Prepare a monitoring and maintenance plan.	Plan																																																										
	Actual																																																											
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan																																																										
	Actual																																																											

2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan Actual	Table of contents was decided. It is being prepared.	
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan Actual	No issue.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual	Table of contents was decided. It is being prepared.	
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan Actual	Completed.	
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan Actual	Completed.	
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan Actual	Completed.	
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan Actual	5 sites damaged by Hurricanes IOTA and ETA in November 2021 were added as target sites.	
3.5. Collect the existing geo-spatial data in the pilot area.	Plan Actual	Completed.	
3.6. Analyze the geo-spatial data in the pilot area.	Plan Actual	Completed.	
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan Actual	Completed.	
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan Actual	The risk level has been discussed. the methodology of creating a risk map was defined	
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan Actual	No issue.	
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan Actual	Table of contents was decided. It is being prepared.	
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan Actual	Seminars on GIS mapping were conducted.	
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan Actual	Table of contents was decided. It is being prepared.	
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan Actual	Completed.	
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan Actual	Completed.	
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan Actual	Completed.	
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan Actual	No issue.	
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan Actual	The draft regulation are being discussed,	
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan Actual	The regulation maps are being discussed.	
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan Actual	The draft regulation was submitted to the legal department in AMDC.	
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan Actual	Table of contents was decided. It is being prepared.	
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan Actual	No issue.	
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual	Table of contents was decided. It is being prepared.	

Monitoring Plan	Year	2019												2020												2021												2022												2023												Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Monitoring																																																																					
Joint Coordinating Committee	Plan Actual																																																																					
Submission of Monitoring Sheet	Plan Actual																																																																					
Reports/Documents																																																																					
Work Plan	Plan Actual																																																																				
Progress Report	Plan Actual																																																																				
Final Report	Plan Actual																																																																				

TO CR of JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.06（Term: September 2022 – February 2023）

Name: Kuwano Takeshi
Title: Team leader
Submission Date: March 17, 2023

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of February 2023
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	55.34 PM (85.67 % of Total PM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	95	95	The report is being finalized.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	90	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	75	75	The structural measure in Villa Nueva by C/P is being designed. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	40	50	The manual is being prepared.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	85	85	The maps are being drafted.
A manual for hazard and risk mapping is prepared.	80	90	The manual is being finalized.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	90	90	The land use regulation is being finalized.
Land use regulation maps for slope disasters for pilot special regime zones are created.	80	80	The land use regulation maps are being finalized.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation

Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	35	The structural measure in Villa Nueva by C/P is being designed. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	95	Action Plan for each Output has been completed. The Integrated Action Plan is being finalized.

1-5 Changes of Risks and Actions for Mitigation

A huge landslide disaster happened in September 2022 in La Guillen next to Nueva Santa Rosa which is the pilot site for landslide in the Project. The disaster affected to Nueva Santa Rosa as well as La Guillen. Since it is necessary to consider the impact of disasters in the countermeasures in Nueva Santa Rosa, countermeasure plans and designs have changed significantly.

1-6 Progress of Actions undertaken by JICA

JICA Expert Team supports AMDC to re-consider the countermeasure plans in La Guillen and Nueva Santa Rosa.

1-7 Progress of Actions undertaken by Gov. of Honduras

AMDC needs to re-consider the countermeasure plans in La Guillen and Nueva Santa Rosa.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

Due to La Guillen disaster, the countermeasure plans have to be changed for Nueva Santa Rosa. The countermeasure works will be completed in December 2025 in La Guillen and Nueva Santa Rosa according

to the new plan prepared by AMDC, while the Project is finished in December 2023.

2-2 Cause

A huge landslide disaster happened in September 2022 in La Guillen.

2-3 Action to be taken

JICA Expert Team supports AMDC to re-consider the countermeasure plans in La Guillen and Nueva Santa Rosa.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

None.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

As Important Assumption in Project Design Matrix in the Project, “In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction” was added.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1] Version: 6.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH) Dated: March 15, 2023
Project Period: 2019 to 2023 (about 4 years and 9 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	The structural measure in Villa Nueva by C/P is being designed. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Action Plan for each Output has been completed. The Integrated Action Plan is being finalized.	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH. ・In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction	The report is being finalized.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			The manual was completed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed.	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites		The structural measure in Villa Nueva by C/P is being designed. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		The manual is being prepared.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map		The maps are being drafted.	
	• A manual for hazard and risk mapping is prepared.	・Manual for hazard and risk mapping		The manual is being finalized.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones		The land use regulation is being finalized.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.	・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation maps are being finalized.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation	Working members are assigned.

1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		**<u>Issues and Countermeasures</u>**

4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 6

Dated: March 17 , 2023

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019												2020												2021												2022												2023												Monitoring: Issue	Monitoring: Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Expert																																																																
Team leader / Slope disaster risk analysis	Plan																																																												
	Actual																																																												
Geological investigation and analysis (Landslide)	Plan																																																											
	Actual																																																											
Structural measures (Landslide)	Plan																																																											
	Actual																																																											
Structural measures (Slope failure and Rockfall)	Plan																																																										
	Actual																																																											
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan																																																										
	Actual																																																											
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan																																																										
	Actual																																																											
Topographic survey	Plan																																																										
	Actual																																																											
Construction Planning/Bid Supervision	Plan																																																										
	Actual																																																											
Construction Supervision	Plan																																																										
	Actual																																																											
Slope disaster hazard evaluation	Plan																																																										
	Actual																																																											
GIS Mapping	Plan																																																										
	Actual																																																											
Land use regulation	Plan																																																										
	Actual																																																											
Land use regulation 1	Plan																																																										
	Actual																																																											
Land use regulation 2	Plan																																																										
	Actual																																																											
Project coordinator/ Training plan	Plan																																																										
	Actual																																																											
Equipment																																																											
Equipement	Plan																																																										
	Actual																																																											
Training in Japan																																																											
Traning in japan	Plan																																																										
	Actual																																																											

Activities / Sub-Activities	Year	2019												2020												2021												2022												2023												Achievements	Issue & Countermeasures
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Output 1:																																																												
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan																																																											
	Actual																																																												
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																											
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan																																																											
	Actual																																																											
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan																																																										
	Actual																																																											
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																											
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan																																																											
	Actual																																																											
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																											
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																											
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan																																																											
	Actual																																																											
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan																																																											
	Actual																																																											
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan																																																											
	Actual																																																											
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan																																																											
	Actual																																																											
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan																																																											
	Actual																																																											
Output 2:																																																											
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan																																																											
	Actual																																																											
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan																																																											
	Actual																																																											
2.3.Conduct the environmental impact/social assessment.	Plan																																																											
	Actual																																																											
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan																																																										
	Actual																																																											
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan																																																											
	Actual																																																											
2.6. Conduct bidding and award process	Plan																																																											
	Actual																																																											
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan																																																											
	Actual																																																											
2.8. Implement and supervise structural measure works.	Plan																																																											
	Actual																																																											
2.9. Prepare a monitoring and maintenance plan.	Plan																																																											
	Actual																																																											
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan																																																											
	Actual																																																											

Monitoring	
No issue.	
Completed.	
2nd training is being prepared.	
Completed.	
Completed.	
Completed.	
Completed. The monitoring is being continued in the landslide sites.	
Completed.	
Completed.	
Completed.	
Completed.	
Completed.	
Proposal report is being finalized.	
Completed.	
No activity	
Completed.	
2 structural measures by C/P are being designed. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.	Continuous discussion is needed for the design of La Guillen and Nueva Santa Rosa.
No activity	
2 sites by C/P are being implemented. Due to La Guillen disaster, the plan was changed for Nueva Santa Rosa.	Continuous discussion is needed for the design of La Guillen and Nueva Santa Rosa.
AMDC approved the budget for Villa Nueva and Nueva Santa Rosa	
2 sites by C/P are being implemented.	
No activity.	
No activity.	
Supervision was conducted for 2 sites by JICA Project..	
The plan was prepared for 2 sites by JICA Project.	
Monitoring and maintenance are being conducted for 2 sites by JICA Project..	

2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan Actual		It is being prepared.
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan Actual		Seminars on design and construction were conducted.
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual		Completed.
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan Actual		Completed.
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan Actual		Completed.
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan Actual		Completed.
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan Actual		Completed.
3.5. Collect the existing geo-spatial data in the pilot area.	Plan Actual		Completed.
3.6. Analyze the geo-spatial data in the pilot area.	Plan Actual		Completed.
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan Actual		Completed.
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan Actual		Method to evaluate the hazard and risk is being discussed.
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan Actual		No activity.
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan Actual		It is being finalized.
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan Actual		Seminars on hazard/risk evaluation and GIS mapping were conducted.
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan Actual		Completed.
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan Actual		Completed.
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan Actual		Completed.
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan Actual		Completed.
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan Actual		No activity.
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan Actual		The land use regulation is being finalized.
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan Actual		The draft map is being finalized.
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan Actual		The draft regulations and map are being finalized.
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan Actual		It is being finalized.
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan Actual		Seminars on land use regulation were conducted.
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan Actual		Completed.

Monitoring Plan	Year	2019												2020												2021												2022												2023												Issue	Solution
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
Monitoring																																																																					
Joint Coordinating Committee	Plan																																																																			
	Actual																																																																					
Submission of Monitoring Sheet	Plan																																																																		
	Actual																																																																					
Reports/Documents																																																																		
Work Plan	Plan																																																																	
	Actual																																																																			
Progress Report	Plan																																																																
	Actual																																																																		
Final Report	Plan																																																																
	Actual																																																																		

Monitoring: Completed. | Reports/Documents: Completed. | Progress report 3 was submitted | (future activity)

TO JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.7.0（Term: March 2023 – September 2023）

Name: Kuwano Takeshi
Title: Team leader
Submission Date: October 11, 2023

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of September 2023
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	63.18 PM (97.82 % of Total PM) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	100	100	The report was completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	100	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	80	80	The structural measure in Villa Nueva is under construction. As for La Guillen and Nueva Santa Rosa, the emergency countermeasure works have been completed. Investigation will be started, followed by the design.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	90	90	The manual is being prepared.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	100	100	The maps were completed.
A manual for hazard and risk mapping is prepared.	100	100	The manual was completed.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	100	100	The land use regulation was completed.
Land use regulation maps for slope disasters for pilot special regime zones are created.	100	100	The land use regulation maps were completed.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achieve	Situation

	ment (%)	
Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	40	The structural measure in Villa Nueva is under construction. As for La Guillen and Nueva Santa Rosa, the emergency countermeasure works have been completed. Investigation will be started, followed by the design.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	100	Action Plan for each Output and the Integrated Action Plan were completed.

1-5 Changes of Risks and Actions for Mitigation

A landslide disaster happened in September 2022 in La Guillen next to Nueva Santa Rosa which is a pilot site for the Project. The disaster affected Nueva Santa Rosa as well as La Guillen. Since it was necessary to consider the impact of the landslide in La Guillen for the countermeasures in Nueva Santa Rosa, these countermeasure plans and designs were significantly changed.

1-6 Progress of Actions undertaken by JICA

JICA Expert Team provides technical advice for the AMDC's activity in La Guillen and Nueva Santa Rosa until December 2025 by extension of the Project period.

1-7 Progress of Actions undertaken by Gov. of Honduras

AMDC proposed a new schedule for 2023 to 2025 to complete the countermeasure works by December 2025 in La Guillen. According to the new schedule, AMDC implements investigation, emergency works and permanent countermeasure works.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

Due to La Guillen disaster, the countermeasure plans must be changed for Nueva Santa Rosa. The countermeasure works will be completed by December 2025 in La Guillen and Nueva Santa Rosa according to the new plan prepared by AMDC.

2-2 Cause

A landslide disaster happened in September 2022 in La Guillen.

2-3 Action to be taken

AMDC proposed a new schedule for 2023 to 2025 to complete the countermeasure works by December 2025 in La Guillen.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

AMDC implements investigation, emergency works and permanent countermeasure works by AMDC's own budget and human resources.

JICA Expert Team provides technical advice for the AMDC's activity in La Guillen and Nueva Santa Rosa until December 2025 by extension of the Project period.

3 Modification of the Project Implementation Plan

3-1 PO

The Project period is modified "from February 2019 to December 2023 (about 4 years and 10 months)" to "from February 2019 to December 2025 (about 6 years and 10 months)."

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Version: 7.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Dated: October 11, 2023
Project Period: 2019 to 2025 (about 6 years and 10 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.*3	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	The structural measure in Villa Nueva is under construction. As for La Guillen and Nueva Santa Rosa, the emergency countermeasure works have been completed. Investigation will be started, followed by the design.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Action Plan for each Output and the Integrated Action Plan were completed.	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH. ・In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction. *3	The report was completed.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			The manual was completed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. *3	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		The structural measure in Villa Nueva is under construction.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			As for La Guillen and Nueva Santa Rosa, the emergency countermeasure works have been completed. Investigation will be started, followed by the design.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		The maps were completed.	
	• A manual for hazard and risk mapping is prepared.			The manual was completed.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation was completed.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.			The land use regulation maps were completed.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation	Working members are assigned.

1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		**<u>Issues and Countermeasures</u>**
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.		

4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

*3: A large-scale landslide disaster occurred in La Guillen, adjacent to Nueva Santa Rosa, one of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work in La Guillen and subsequent amendments to the countermeasure plans and designs for Nueva Santa Rosa. The Important Assumption “Significant disasters involving large-scale topographical alterations will NOT occur during the survey and construction period” has been invalidated.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 7.0

Dated: October 11, 2023

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	2024	2025	Monitoring: Issue	Monitoring: Solution
Expert									The Project is extended until the end of 2025.	Team leader, Geological investigation and analysis, Structural measures and Project coordinator will be assigned in 2024 and 2025.
Team leader / Slope disaster risk analysis	Plan / Actual									
Geological investigation and analysis (Landslide)	Plan / Actual									
Structural measures (Landslide)	Plan / Actual									
Structural measures (Slope failure and Rockfall)	Plan / Actual									
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual									
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual									
Topographic survey	Plan / Actual									
Construction Planning/Bid Supervision	Plan / Actual									
Construction Supervision	Plan / Actual									
Slope disaster hazard evaluation	Plan / Actual									
GIS Mapping	Plan / Actual									
Land use regulation	Plan / Actual									
Land use regulation 1	Plan / Actual									
Land use regulation 2	Plan / Actual									
Project coordinator/ Training plan	Plan / Actual									
Equipment									Completed.	
Equipement	Plan / Actual									
Training in Japan									Completed.	
Traning in japan	Plan / Actual									

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	2024	2025	Achievements	Issue & Countermeasures
Output 1:										
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual								Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual								Original schedule was completed.	The activity is newly needed in Nueva Santa Rosa and La Guillen.
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual								Proposal report has been finalized.	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual								The manual has been finalized and distributed.	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual								All trainings and seminars have been implemented.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	
Output 2:										
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual								It was completed in Villa Nueva. As for La Guillen and Nueva Santa Rosa, the emergency measures have been completed.	The design of the countermeasure works are needed in La Guillen and Nueva Santa Rosa.
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual								Completed.	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual								The procedure for Unnecessary of Environmental Evaluation License is not required for Nueva Santa Rosa.	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual								AMDC approved the budget for Nueva Santa Rosa in 2024.	
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual								It was completed in Villa Nueva.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
2.6. Conduct bidding and award process	Plan / Actual								It was completed in Villa Nueva.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual								It was completed in Villa Nueva.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
2.8. Implement and supervise structural measure works.	Plan / Actual								Supervision is being conducted in Villa Nueva.	It will be needed in La Guillen and Nueva Santa Rosa in 2025.
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual								It is completed for 2 sites by JICA Project.	It will be needed in La Guillen and Nueva Santa Rosa in 2025.
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual								Monitoring and maintenance are being conducted for 2 sites by JICA Project..	It will be needed for 4 pilot sites.
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan / Actual								It is being prepared.	
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan / Actual								Seminars on construction and maintence were conducted.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	

Output 3:

Activity		Issue	Solution
3.1. Review slope disaster risk related maps and related information	Plan	Completed.	
	Actual		
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan	Completed.	
	Actual		
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan	Completed.	
	Actual		
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan	Completed.	
	Actual		
3.5. Collect the existing geo-spatial data in the pilot area.	Plan	Completed.	
	Actual		
3.6. Analyze the geo-spatial data in the pilot area.	Plan	Completed.	
	Actual		
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan	Completed.	
	Actual		
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan	The level of hazard and risk has been defined.	
	Actual		
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan	SIMET has been updated.	
	Actual		
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan	The manual has been finalized and distributed.	
	Actual		
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan	All trainings and seminars have been implemented.	
	Actual		
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan	Completed.	
	Actual		

Output 4:

Activity		Issue	Solution
4.1. Review the current approach and information on the land use regulation	Plan	Completed.	
	Actual		
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan	Completed.	
	Actual		
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan	Completed.	
	Actual		
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan	The technical materials have been completed.	
	Actual		
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan	The land use regulation has been finalized	
	Actual		
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan	The map has been finalized.	
	Actual		
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan	The land use regulation and maps were officially approved..	
	Actual		
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan	The manual has been finalized and distributed.	
	Actual		
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan	All trainings and seminars have been implemented.	
	Actual		
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan	Completed.	
	Actual		

Monitoring Plan	Year	Issue	Solution
	2019 / 2020 / 2021 / 2022 / 2023 / 2024 / 2025 (months 1–12)		
Monitoring			
Joint Coordinating Committee	Plan	The Project is extended until the end of 2025.	JCC will be added 4 times.
	Actual		
Submission of Monitoring Sheet	Plan		
	Actual		
Reports/Documents			
Work Plan	Plan	Completed.	
	Actual		
Progress Report	Plan	The Project is extended until the end of 2025.	Progress report ver.4 and ver.5 will be needed.
	Actual		
Final Report	Plan	(future activity)	
	Actual		

TO JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.8.0　(Term: October 2023 – March 2024)

Name: Kuwano Takeshi
Title: Team leader
Submission Date: March 15, 2024

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of February 2024
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	65.21 PM (83.37 % of Total PM: 78.22) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	100	100	The report was completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	100	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	87	87	Construction in Villa Nueva was delayed due to relocation issues, which began in March 2024. As for La Guillen and Nueva Santa Rosa, the survey is delayed. The design for permanent measures has been initiated based on current data and on-site survey results.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	92	92	The manual is being prepared.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	100	100	The maps were completed.
A manual for hazard and risk mapping is prepared.	100	100	The manual was completed.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	100	100	The land use regulation was completed.
Land use regulation maps for slope disasters for pilot special regime zones are created.	100	100	The land use regulation maps were completed.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achieve	Situation

	ment (%)	
Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	50	Construction in Villa Nueva was delayed due to relocation issues, which began in March 2024. As for La Guillen and Nueva Santa Rosa, the survey is delayed. The design for permanent measures has been initiated based on current data and on-site survey results.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	100	Action Plan for each Output and the Integrated Action Plan were completed.

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

1) Drilling surveys are delayed in La Guillen.

2) Construction was delayed in Villa Nueva.

2-2 Cause

1) Due to delays in the procurement of monitoring devices by the contractor and in payments from AMDC, the contractor is withdrawing from the survey.

2) Temporary relocation for three houses was necessary.

2-3 Action to be taken

1) The design has been initiated based on current data and on-site survey results, which will be adjusted based on the results of the drilling surveys.

2) The relocation issues have been resolved.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

1)

AMDC will contract with another contractor immediately to restart the survey.

JICA Expert Team will conduct stability analysis to revise cross-sections and set strength constants for slip surfaces based on the survey results.

2)

AMDC will implement proper supervision for the construction.

JICA Expert Team will provide continuous technical support to ensure that the construction is completed before the rainy season.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Project Period: 2019 to 2025 (about 6 years and 10 months)
Project Site: The Central District

Version: 8.0
Dated: March 15, 2024

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.*3	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	Construction in Villa Nueva was delayed due to relocation issues, which began in March 2024. As for La Guillen and Nueva Santa Rosa, the survey is delayed. The design for permanent measures has been initiated based on current data and on-site survey results.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Action Plan and Operational Plan were completed.	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH. ・In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction. *3	The report was completed.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			The manual was completed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. *3	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		Construction in Villa Nueva was delayed due to relocation issues, which began in March 2024. As for La Guillen and Nueva Santa Rosa, the survey is delayed. The design for permanent measures has been initiated based on current data and on-site survey results.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			The manual is being prepared.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map ・Manual for hazard and risk mapping		The maps were completed.	
	• A manual for hazard and risk mapping is prepared.			The manual was completed.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones ・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation was completed.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.			The land use regulation maps were completed.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey	Working members are assigned.

and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model <u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.		**<u>Issues and Countermeasures</u>**

3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

*3: A large-scale landslide disaster occurred in La Guillen, adjacent to Nueva Santa Rosa, one of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work in La Guillen and subsequent amendments to the countermeasure plans and designs for Nueva Santa Rosa. The Important Assumption “Significant disasters involving large-scale topographical alterations will NOT occur during the survey and construction period” has been invalidated.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 8.0
Dated: March 15, 2024

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	2024	2025	Monitoring: Issue	Monitoring: Solution
Expert										
Team leader / Slope disaster risk analysis	Plan									
	Actual									
Geological investigation and analysis (Landslide)	Plan									
	Actual									
Structural measures (Landslide)	Plan									
	Actual									
Structural measures (Slope failure and Rockfall)	Plan									
	Actual									
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan									
	Actual									
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan									
	Actual									
Topographic survey	Plan									
	Actual									
Construction Planning/Bid Supervision	Plan								No issue.	
	Actual									
Construction Supervision	Plan									
	Actual									
Slope disaster hazard evaluation	Plan									
	Actual									
GIS Mapping	Plan									
	Actual									
Land use regulation	Plan									
	Actual									
Land use regulation 1	Plan									
	Actual									
Land use regulation 2	Plan									
	Actual									
Project coordinator/ Training plan	Plan									
	Actual									
Equipment										
Equipement	Plan								Completed.	
	Actual									
Training in Japan										
Traning in japan	Plan								Completed.	
	Actual									

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	2024	2025	Achievements	Issue & Countermeasures
Output 1:										
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan								Completed.	
	Actual									
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan								Completed.	
	Actual									
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan								Completed.	
	Actual									
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan								The borehole surveys are delayed.	The design has been initiated based on current data and on-site survey results.
	Actual									
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan								Completed.	
	Actual									
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan								Completed.	
	Actual									
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan								Completed.	
	Actual									
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan								Completed.	
	Actual									
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan								Completed.	
	Actual									
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan								Completed.	
	Actual									
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan								Completed.	
	Actual									
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan								Completed.	
	Actual									
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan								Completed.	
	Actual									
Output 2:										
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan								A small-scale landslide occurred at the base of the Nueva Santa Rosa site. The design for permanent measures has been initiated.	Prompt emergency measures are implemented for the small landslide.
	Actual									
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan								Completed.	
	Actual									
2.3.Conduct the environmental impact/social assessment.	Plan								Completed.	
	Actual									
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan								22 million Ls was approved in 2024.	A request for 20 million Ls for 2025 should be made.
	Actual									
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan								No activity in this period.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
	Actual									
2.6. Conduct bidding and award process	Plan								No activity in this period.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
	Actual									
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan								No activity in this period.	It will be needed in La Guillen and Nueva Santa Rosa in 2024.
	Actual									
2.8. Implement and supervise structural measure works.	Plan								Construction in Villa Nueva was delayed due to relocation issues.	The relocation issues have been resolved. The construction should be completed before the rainy season.
	Actual									
2.9. Prepare a monitoring and maintenance plan.	Plan								No activity in this period.	It will be needed in La Guillen and Nueva Santa Rosa, and Villa Nueva in 2024 and 2025.
	Actual									
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan								No activity in this period.	It will be needed in La Guillen and Nueva Santa Rosa, and Villa Nueva in 2024 and 2025.
	Actual									
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan								No activity in this period.	
	Actual									
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan								No activity in this period.	
	Actual									
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan								Completed.	
	Actual									

Output 3:

Activity		Issue	Solution
3.1. Review slope disaster risk related maps and related information	Plan / Actual	Completed.	
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan / Actual	Completed.	
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan / Actual	Completed.	
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan / Actual	Completed.	
3.5. Collect the existing geo-spatial data in the pilot area.	Plan / Actual	Completed.	
3.6. Analyze the geo-spatial data in the pilot area.	Plan / Actual	Completed.	
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan / Actual	Completed.	
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan / Actual	Completed.	
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan / Actual	Completed.	
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan / Actual	Completed.	
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan / Actual	Completed.	
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan / Actual	Completed.	To ensure that activities aligned with the Action Plan are being executed, continue to review.

Output 4:

Activity		Issue	Solution
4.1. Review the current approach and information on the land use regulation	Plan / Actual	Completed.	
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan / Actual	Completed.	
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan / Actual	Completed.	
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan / Actual	Completed.	
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan / Actual	Completed.	
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan / Actual	Completed.	
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan / Actual	Completed.	
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan / Actual	Completed.	
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan / Actual	Completed.	
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual	Completed.	To ensure that activities aligned with the Action Plan are being executed, continue to review.

Monitoring Plan	Year: 2019–2025 (months 1–12)	Issue	Solution
Monitoring			
Joint Coordinating Committee	Plan / Actual	The JCC is postponed.	The direct meeting with the Mayor is held instead of the JCC.
Submission of Monitoring Sheet	Plan / Actual		
Reports/Documents			
Work Plan	Plan / Actual	Completed.	
Progress Report	Plan / Actual	Progress report ver.4 was submitted.	
Final Report	Plan / Actual	(future activity)	

TO JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.9.0 (Term: April 2024 – September 2024)

Name: Kuwano Takeshi
Title: Team leader
Submission Date: September 30, 2024

I. Summary

1 Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of September 2024
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	69.81 PM (89.25 % of Total PM: 78.22) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	100	100	The report was completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	100	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	89	89	Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing. As for La Guillen and Nueva Santa Rosa, all designs have been completed, but bidding document preparations are behind schedule for starting construction in November 2024.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	94	94	The manual is complete, except for the maintenance section, which will be prepared during the maintenance stage in 2025.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	100	100	The maps were completed.
A manual for hazard and risk mapping is prepared.	100	100	The manual was completed.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	100	100	The land use regulation was completed.
Land use regulation maps for slope disasters for pilot special regime zones are created.	100	100	The land use regulation maps were completed.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	60	Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing. As for La Guillen and Nueva Santa Rosa, all designs have been completed, but bidding document preparations are behind schedule for starting construction in November 2024.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	100	Action Plan for each Output and the Integrated Action Plan were completed.

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

1) Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing.

2) As for La Guillen and Nueva Santa Rosa, all designs have been completed, but bidding document preparations are behind schedule for starting construction in November 2024.

2-2 Cause

1) Due to delays in the study and redesign by AMDC.

2) Suspension of the preparation of the bidding documents

2-3 Action to be taken

1) It is desirable for AMDC to proceed with the study and redesign immediately.

2) It is desirable for AMDC to proceed with the preparation of the bidding documents immediately.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

1) AMDC will proceed with the study and redesign immediately for starting construction in November 2024. JICA Expert Team will be able to give technical advice if needed.

2) AMDC will proceed with the preparation of the bidding documents immediately.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Project Period: 2019 to 2025 (about 6 years and 10 months)
Project Site: The Central District

Version: 9.0
Dated: September 30, 2024

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.*3	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing. As for La Guillen and Nueva Santa Rosa, all designs have been completed, but bidding document preparations are behind schedule for starting construction in November 2024.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is	2. Document on "Action Plan for Risk Reduction for Slope		Action Plan and Operational Plan were completed.	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

	created.	Disasters in the Central District"			
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH.	The report was completed.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			The manual was completed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. *3	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk	・In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction. *3	Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing. As for La Guillen and Nueva Santa Rosa, all designs have been completed, but bidding document preparations are behind schedule for starting construction in November 2024.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			The manual is complete, except for the maintenance section, which will be prepared during the maintenance stage in 2025.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map		The maps were completed.	
	• A manual for hazard and risk mapping is prepared.	・Manual for hazard and risk mapping		The manual was completed.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones		The land use regulation was completed.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.	・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation maps were completed.	

Activities	**Input**	**Pre-condition**

1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model <u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	Working members are assigned.
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area.		**<u>Issues and Countermeasures</u>**

3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8. 3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

*3: A large-scale landslide disaster occurred in La Guillen, adjacent to Nueva Santa Rosa, one of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work in La Guillen and subsequent amendments to the countermeasure plans and designs for Nueva Santa Rosa. The Important Assumption “Significant disasters involving large-scale topographical alterations will NOT occur during the survey and construction period” has been invalidated.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 9.0

Dated: September 30, 2024

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	2024	2025	Monitoring: Issue	Monitoring: Solution
Expert										
Team leader / Slope disaster risk analysis	Plan / Actual								No issue.	
Geological investigation and analysis (Landslide)	Plan / Actual									
Structural measures (Landslide)	Plan / Actual									
Structural measures (Slope failure and Rockfall)	Plan / Actual									
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual									
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual									
Topographic survey	Plan / Actual									
Construction Planning/Bid Supervision	Plan / Actual									
Construction Supervision	Plan / Actual									
Slope disaster hazard evaluation	Plan / Actual									
GIS Mapping	Plan / Actual									
Land use regulation	Plan / Actual									
Land use regulation 1	Plan / Actual									
Land use regulation 2	Plan / Actual									
Project coordinator/ Training plan	Plan / Actual									
Equipement	Plan / Actual								Completed.	
Training in Japan										
Traning in japan	Plan / Actual								Completed.	

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	2024	2025	Achievements	Issue & Countermeasures
Output 1:										
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual								Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual								Completed.	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								All surveys have been completed.	Monitoring needs to continue.
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual								Completed.	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual								All analyses have been completed.	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual								Completed.	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual								Completed.	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual								Completed.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	
Output 2:										
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual								All designs have been completed.	Any minor design revisions will be addressed as needed.
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual								Completed.	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual								Completed.	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual								40 million Ls in 2024 and 20 millions Ls in 2025 were approved.	Continuously monitor the budget status for 2025 and 2026.
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual								Preparations are behind schedule for starting construction in November 2024.	It is essential to start immediately.
2.6. Conduct bidding and award process	Plan / Actual								No activity in this period.	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual								No activity in this period.	
2.8. Implement and supervise structural measure works.	Plan / Actual								Construction in Villa Nueva started in April 2024, but a collapse occurred in June 2024. Study and redesign by AMDC are ongoing.	It is essential to start immediately in Villa Nueva.
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual								No activity in this period.	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual								Monitoring is ongoing.	It is needed in La Guillen and Nueva Santa Rosa, and Villa Nueva in 2024 and 2025.
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan / Actual								The manual is complete, except for the maintenance section.	It will be prepared during the maintenance stage in 2025.
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan / Actual								No activity in this period.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	

Output 3:

Activity		Issue	Solution
3.1. Review slope disaster risk related maps and related information	Plan	Completed.	
	Actual		
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan	Completed.	
	Actual		
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan	Completed.	
	Actual		
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan	Completed.	
	Actual		
3.5. Collect the existing geo-spatial data in the pilot area.	Plan	Completed.	
	Actual		
3.6. Analyze the geo-spatial data in the pilot area.	Plan	Completed.	
	Actual		
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan	Completed.	
	Actual		
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan	Completed.	
	Actual		
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan	Completed.	
	Actual		
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan	Completed.	
	Actual		
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan	Completed.	
	Actual		
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan	Completed.	
	Actual		
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan	Completed.	
	Actual		
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan	Completed.	
	Actual		
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan	Completed.	
	Actual		
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan	Completed.	
	Actual		
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan	Completed.	
	Actual		
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan	Completed.	
	Actual		
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan	Completed.	
	Actual		
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan	Completed.	
	Actual		
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan	Completed.	
	Actual		
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan	Completed.	
	Actual		

Monitoring Plan	Year	2019	2020	2021	2022	2023	2024	2025	Issue	Solution
		1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5	6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12		
Monitoring										
Joint Coordinating Committee	Plan								The JCC is postponed.	The JCC may be held in November. Direct meetings with the Mayor are held instead of the JCC.
	Actual									
Submission of Monitoring Sheet	Plan									
	Actual									
Reports/Documents										
Work Plan	Plan								Completed.	
	Actual									
Progress Report	Plan								No issue.	
	Actual									
Final Report	Plan								(future activity)	
	Actual									

TO JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.10.0　(Term: October 2024 – March 2025)

Name: Kuwano Takeshi
Title: Team leader
Submission Date: March 31, 2025

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of March 2025
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	71.75 PM (91.73 % of Total PM: 78.22) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	100	100	The report was completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	100	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	95	89	As for La Guillen and Nueva Santa Rosa, JET had advised AMDC to commence construction in November 2024 to ensure the completion of high risk parts of the works before the rainy season, by May 2025. However, AMDC implements additional retaining wall as a part of countermeasures, which required further geological surveys and revision of designs. Consequently, the construction could not commence in November 2024. The additional retaining wall will be verified after the completion of the original works. The original countermeasure construction is scheduled to commence in April 2025. For Villa Nueva, JET had advised AMDC to commence construction in November 2023 that the removal of the highest risk unstable rock masses be completed before the rainy season, by May 2024. However, the actual commencement of construction was significantly delayed until April 2024. Consequently, the removal of the unstable rock masses postponed into the rainy season, and on June 29, 2024, a slope failure occurred due to continuous rainfall. Under this situation, AMDC is conducting a geological survey with support from UNAH for revised countermeasure works. The revised countermeasure construction after the slope failure is scheduled to commence in April 2025. As a result, the original countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva,

			which are managed by AMDC, will not be completed by December 2025, the end of the Project (JICA has extended the Project for two (2) years). JET will support the supervision for the construction until October 2025 including the rainy season, which marks the closure of activities in Honduras, as JET will have fully achieved its project objective for technical transfer for supervision.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	95	95	The manual in the maintenance section is under preparation. It will be prepared in April 2025.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	100	100	The maps were completed.
A manual for hazard and risk mapping is prepared.	100	100	The manual was completed.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	100	100	The land use regulation was completed.
Land use regulation maps for slope disasters for pilot special regime zones are created.	100	100	The land use regulation maps were completed.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	60	The original countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva, which are managed by AMDC, will not be completed by December 2025, the end of the Project (JICA has extended the Project for two (2) years). JET will support the supervision for the construction until October 2025 including the rainy season, which marks the closure of activities in Honduras, as JET will have fully achieved its project objective for technical transfer for supervision.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	100	Action Plan for each Output and the Integrated Action Plan were completed.

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

The original countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva, which are managed by AMDC, is scheduled to commence in April 2025 and will not be completed by December 2025, the end of the Project though JICA has extended the Project for two (2) years.

2-2 Cause

As for La Guillen and Nueva Santa Rosa, JET had advised AMDC to commence construction in November 2024 to ensure the completion of high-risk parts of the works before the rainy season, by May 2025. However, AMDC implements additional retaining wall as a part of countermeasures, which required further geological surveys and revision of designs. Consequently, the construction could not commence in November 2024.

For Villa Nueva, JET had advised AMDC to commence construction in November 2023 that the removal of the highest risk unstable rock masses be completed before the rainy season, by May 2024. However, the actual commencement of construction was significantly delayed until April 2024. Consequently, the removal of the unstable rock masses postponed into the rainy season, and on June 29, 2024, a slope failure occurred due to continuous rainfall. Under this situation, AMDC is conducting a geological survey with support from UNAH for revised countermeasure works.

2-3 Action to be taken

JET will support the supervision for the construction until October 2025 including the rainy season, which marks the closure of activities in Honduras, as JET will have fully achieved its project objective for technical transfer for supervision.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

1) JET continuously provide technical support, including supervision assistance until October 2025, to ensure a smooth implementation process, as outlined below.

- Advise on the procedures and schedules, ensuring that the highest risk works of collapse should not be carried out during the rainy season but should be completed during the dry season.
- Provide technical advice and documents summarizing the tasks, schedule, technical considerations for the supervision related to the construction of the remaining countermeasure works, and the plans for post-construction maintenance and monitoring.

2) After October 2025, AMDC will take full responsibility for supervision based on the technology and knowledge it has acquired from JET. Since the construction for the additional retaining walls designed by AMDC in La Guillén and Nueva Santa Rosa will not commence by October 2025, JET will not provide supervision for the retaining walls.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Version: 10.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Dated: March 31, 2025
Project Period: 2019 to 2025 (about 6 years and 10 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.*3	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	The original countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva, which are managed by AMDC, will not be completed by December 2025, the end of the Project (JICA has extended the Project for two (2) years). JET will support the supervision for the construction until October 2025 including the rainy season, which marks the closure of activities in Honduras, as JET will have fully achieved its project objective for technical transfer	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

				for supervision. Footnote *3 is added into the PDM.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Action Plan and Operational Plan were completed.	
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced. • A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH. ・In the pilot site and its surroundings, significant disasters with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction. *3	The report was completed. The manual was completed.	
2. Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.	• 4 structural measures for small/medium size slope disaster risks are constructed. *3	・Project designs of 4 structural measures for small/medium size slopes ・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk		As for La Guillen and Nueva Santa Rosa, JET had advised AMDC to commence construction in November 2024 to ensure the completion of high risk parts of the works before the rainy season, by May 2025. However, AMDC implements additional retaining wall as a part of countermeasures, which required further geological surveys and revision of designs. Consequently, the construction could not commence in November 2024. The additional retaining wall will be verified after the completion of the original works. The original countermeasure construction is scheduled to commence in April 2025. For Villa Nueva, JET had advised AMDC to commence construction in November 2023 that the removal of the highest risk unstable rock masses be completed before the rainy season, by May 2024. However, the actual commencement of construction was significantly delayed until April 2024. Consequently, the removal of the unstable rock masses postponed into the rainy season, and on June 29, 2024, a slope failure occurred due to continuous rainfall.	

				Under this situation, AMDC is conducting geological survey with support from UNAH for revised countermeasure works. The revised countermeasure construction after the slope failure is scheduled to commence in April 2025. As a result, the original countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva, which are managed by AMDC, will not be completed by December 2025, the end of the Project (JICA has extended the Project for two (2) years). JET will support the supervision for the construction until October 2025 including the rainy season, which marks the closure of activities in Honduras, as JET will have fully achieved its project objective for technical transfer for supervision. Footnote *3 is added into the PDM.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			The manual in the maintenance section is under preparation. It will be prepared in April 2025.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map		The maps were completed.	
	• A manual for hazard and risk mapping is prepared.	・Manual for hazard and risk mapping		The manual was completed.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones		The land use regulation was completed.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.	・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation maps were completed.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial	<u>Input: Japanese Side</u> 1. Experts 1) Team leader 2) Geological investigation and	Working members are assigned.

information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8.		**<u>Issues and Countermeasures</u>**

3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

*3: Large-scale landslide disaster occurred in September 2022 in La Guillen, adjacent to Nueva Santa Rosa, and in June 2024 in Villa Nueva, both of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work and subsequent amendments to the countermeasure plans and designs for both pilot sites. Even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that the Project Objective and Output 2 have sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and maintenance of structural measures, as well as formulating relevant plans. The Important Assumption “Significant disasters involving large-scale topographical alterations will NOT occur during the survey and construction period” has been invalidated.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 10.0
Dated: March 31, 2025

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	2024	2025	Monitoring: Issue	Monitoring: Solution
Expert										
Team leader / Slope disaster risk analysis	Plan / Actual								No issue.	
Geological investigation and analysis (Landslide)	Plan / Actual									
Structural measures (Landslide)	Plan / Actual									
Structural measures (Slope failure and Rockfall)	Plan / Actual									
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual									
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual									
Topographic survey	Plan / Actual									
Construction Planning/Bid Supervision	Plan / Actual									
Construction Supervision	Plan / Actual									
Slope disaster hazard evaluation	Plan / Actual									
GIS Mapping	Plan / Actual									
Land use regulation	Plan / Actual									
Land use regulation 1	Plan / Actual									
Land use regulation 2	Plan / Actual									
Project coordinator/ Training plan	Plan / Actual									
Equipment										
Equipement	Plan / Actual								Completed.	
Training in Japan										
Traning in japan	Plan / Actual								Completed.	

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	2024	2025	Achievements	Issue & Countermeasures
Output 1:										
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual								Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual								Completed.	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								All surveys have been completed.	Monitoring needs to continue.
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual								Completed.	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual								Completed.	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual								Completed.	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual								Completed.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	
Output 2:										
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual								Revised countermeasures were designed by AMDC for Villa Nueva following the collapse in June 2024.	Additional geological surveys and stability analyses are needed to verify the countermeasure
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual								Completed.	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual								Completed.	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual								A budget of 96 million Ls was prepared for Nueva Santa Rosa and La Guillen, and 32 million Ls for Villa Nueva.	A budget of a similar amount is expected to be allocated in 2025.
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual								All the bidding documents have been prepared.	
2.6. Conduct bidding and award process	Plan / Actual								Due to the emergency response to the disaster, direct contracts are being processed for both sites.	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual								Direct contracts are being processed for both sites.	The construction is expected to start in April.
2.8. Implement and supervise structural measure works.	Plan / Actual								No activity in this period.	
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual								No activity in this period.	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual								No activity in this period.	
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan / Actual								The manual in the maintenance section is under preparation.	It will be prepared in mid-2025.
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan / Actual								No activity in this period.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	

Output 3:

3.1. Review slope disaster risk related maps and related information	Plan / Actual	Completed.
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan / Actual	Completed.
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan / Actual	Completed.
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan / Actual	Completed.
3.5. Collect the existing geo-spatial data in the pilot area.	Plan / Actual	Completed.
3.6. Analyze the geo-spatial data in the pilot area.	Plan / Actual	Completed.
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan / Actual	Completed.
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan / Actual	Completed.
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan / Actual	Completed.
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan / Actual	Completed.
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan / Actual	Completed.
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan / Actual	Completed.

Output 4:

4.1. Review the current approach and information on the land use regulation	Plan / Actual	Completed.
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan / Actual	Completed.
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan / Actual	Completed.
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan / Actual	Completed.
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan / Actual	Completed.
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan / Actual	Completed.
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan / Actual	Completed.
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan / Actual	Completed.
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan / Actual	Completed.
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual	Completed.

Monitoring Plan	Year	2019	2020	2021	2022	2023	2024	2025	Issue	Solution
		1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12		
Monitoring										
Joint Coordinating Committee	Plan / Actual								The JCC meetings in March and September 2024 have been postponed.	The JCC meeting is held in March 2025.
Submission of Monitoring Sheet	Plan / Actual									
Reports/Documents										
Work Plan	Plan / Actual								Completed.	
Progress Report	Plan / Actual								Completed.	
Final Report	Plan / Actual								(future activity)	

TO JICA HONDURAS OFFICE

PROJECT MONITORING SHEET

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District
Version of the Sheet: Ver.11.0　(Term: March 2025 – October 2025)

Name: Kuwano Takeshi
Title: Team leader
Submission Date: October 14, 2025

I. Summary

1　Progress

1-1 Progress of Inputs

Inputs	Plan as of February 2019	Actual as of October 2025
Japanese Side Experts	Total PM: 54.80 PM 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator	78.22 PM (100 % of Total PM: 78.22) 1) Team leader 2) Geological investigation and analysis 3) Topographic survey 4) Structural measures 5) Construction Planning/Bid Supervision 6) Construction Supervision 7) Slope disaster hazard evaluation 8) GIS mapping 9) Land use regulation 10) Coordinator
Japanese Side Training (Japan, Third Countries)	・ Training on Slope Disaster Risk Reduction	・ Training on Slope Disaster Risk Reduction
Procurement of Equipment	・ Digital Terrain Model	・ Digital Terrain Model
Honduras Side	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects	(1) Counterpart Personnel: 1) Project Director (Mayor of AMDC) 2) Project Manager (Coordinator of UMGIR) 3) WG members for Output 1 4) WG members for Output 2 5) WG members for Output 3 6) WG members for Output 4 (2) Working Space and Facilities for JICA Experts at: ・ UMGIR ・ UNAH (3) Project Cost: ・ Local operation cost ・ Construction of 2 pilot projects

1-2 Progress of Activities

Progress of activities is indicated in Monitoring Sheet Form 3-2 (PDM) and Form 3-3 (PO).

1-3 Achievement of Output

Output/indicators	Achievement (%)		Major results
	Plan	Actual	
Output 1: Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.			
Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	100	100	The report was completed.
A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.	100	100	The manual was completed.
Output 2: Capacity to design, construct, supervise, and maintain structural measures for small/medium size slope disaster risk is enhanced.			
4 structural measures for small/medium size slope disaster risks are constructed.	100	100	Large-scale slope disaster occurred in September 2022 in La Guillen, adjacent to Nueva Santa Rosa, and in June 2024 in Villa Nueva, both of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work and subsequent amendments to the countermeasure plans and designs for both pilot sites. The Important Assumption in the PDM has been invalidated. All the parties agreed at the 8th JCC held in March 2025 and signed the minutes, confirming that the essential purpose of the Project is to enhance the understanding of the AMDC, COPECO and UNAH on slope disaster risk reduction against landslides, slope failures, and rockfalls through the process of (i) monitoring, (ii) analysis and diagnosis, and (iii) countermeasure planning. Through the activities implemented under Outputs 1 and 2, the AMDC, COPEO and UNAH have acquired these technical skills in slope disaster management, and therefore it can be concluded that the fundamental purpose of the Project has been achieved. Furthermore, it was recognized that even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that the Project Objective in the PDM has sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and

			maintenance of structural measures, as well as formulating relevant plans.
A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.	100	100	The manual was completed.
Output 3: Capacity to develop hazard and risk maps is enhanced.			
The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	100	100	The maps were completed.
A manual for hazard and risk mapping is prepared.	100	100	The manual was completed.
Output 4: Capacity to regulate land use for slope disasters is enhanced.			
A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	100	100	The land use regulation was completed.
Land use regulation maps for slope disasters for pilot special regime zones are created.	100	100	The land use regulation maps were completed.

1-4 Achievement of the Project Purpose

Project purpose/indicators	Achievement (%)	Situation
Project purpose: Capacity to manage slope disasters in the Central District is improved.		
1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.	100	As mentioned in the Output 2 above, the essential purpose of the Project is to enhance the understanding of the AMDC, COPEO and UNAH on slope disaster risk reduction against landslides, slope failures, and rockfalls through the process of (i) monitoring, (ii) analysis and diagnosis, and (iii) countermeasure planning. Through the activities implemented under Outputs 1 and 2, the AMDC, COPECO and UNAH have acquired these technical skills in slope disaster management, and therefore it can be concluded that the fundamental purpose of the Project has been achieved. Furthermore, it was recognized that even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that Output 2 in the PDM has sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and maintenance of structural measures, as well as formulating relevant plans.
2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	100	Action Plan for each Output and the Integrated Action Plan were completed.

1-5 Changes of Risks and Actions for Mitigation

None.

1-6 Progress of Actions undertaken by JICA

None.

1-7 Progress of Actions undertaken by Gov. of Honduras

None.

1-8 Progress of Environmental and Social Considerations (if applicable)

None.

1-9 Progress of Considerations on Gender/Peace Building/Poverty Reduction (if applicable)

None.

1-10 Other remarkable/considerable issues related/affect to the project (such as other JICA's projects, activities of counterparts, other donors, private sectors, NGOs etc.)

None.

2 Delay of Work Schedule and/or Problems (if any)

2-1 Detail

The countermeasure works for Nueva Santa Rosa (La Guillen) and Villa Nueva, which are managed by AMDC, was commenced in October 2025 and will not be completed by December 2025, the end of the Project though JICA has extended the Project for two (2) years.

2-2 Cause

As for La Guillen and Nueva Santa Rosa, JET had advised AMDC to commence construction in November 2024 to ensure the completion of high-risk parts of the works before the rainy season, by May 2025. However, AMDC wanted to implement additional retaining wall as a part of countermeasures, which required further geological surveys and revision of designs. Consequently, the construction could not commence in November 2024.

For Villa Nueva, JET had advised AMDC to commence construction in November 2023 that the removal of the highest risk unstable rock masses be completed before the rainy season, by May 2024. However, the actual commencement of construction was significantly delayed until April

2024. Consequently, the removal of the unstable rock masses postponed into the rainy season, and on June 29, 2024, a slope failure occurred due to continuous rainfall.

2-3 Action to be taken

After October 2025, AMDC will perform the supervision for the construction works based on the technology and knowledge acquired from JET. To support AMDC in managing future works independently, JET and AMDC prepared a construction supervision plan outlining key points to be considered and provided guidance to AMDC. Based on this plan, AMDC held discussions with the contractor and consultant and formulated the construction plan. In addition, JET and AMDC have develop monitoring and maintenance plans for the pilot sites of the Project—Campo Cielo, Fuerzas Unidas, Nueva Santa Rosa & La Guillen, and Villa Nueva. A monitoring and maintenance manual was also prepared to facilitate technology transfer.

2-4 Roles of Responsible Persons/Organization (JICA, Gov. of Honduras, etc.)

AMDC is responsible for promptly implementing the countermeasure works for the landslide in Nueva Santa Rosa and La Guillen, as well as the slope failure and rockfall in Villa Nueva, utilizing the knowledge transferred from JET through the pilot activities in Campo Cielo and Fuerzas Unidas. In doing so, AMDC is required to carry out the works with due consideration for safety, avoiding the rainy season in light of the extremely high risks associated with construction during that period.

3 Modification of the Project Implementation Plan

3-1 PO

None.

3-2 Other modifications on detailed implementation plan

None.

4 Preparation of Gov. of Honduras toward after completion of the Project

None.

II. Project Monitoring Sheet I & II *as Attached*

Project Monitoring Sheet I (Revision of Project Design Matrix)

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District[1]
Version: 11.0
Implementing Agency: The Central District Municipal Government (AMDC), National Disaster Prevention Committee (COPECO), National Autonomous University of Honduras (UNAH)
Dated: October 14, 2025
Project Period: 2019 to 2025 (about 6 years and 10 months)
Project Site: The Central District

Narrative Summary	Objectively Verifiable Indicator	Means of Verification	Important Assumption	Achievement	Remarks
Overall Goal					
Necessary actions for control and mitigation for slope disaster risks in the -Central District will be undertaken based on the Action Plan for Risk Reduction for Slope Disasters in the Central District (the Action Plan)[2].	• Number of people living under slope disaster risks is reduced by implementing countermeasures based on the Action Plan. • 2 countermeasures for slope disasters risks in accordance with the Action Plan are undertaken within 3 years after the project completion. • The newly created land use regulation for special regime zones in Central District based on the Action Plan.	• Statistical data managed by AMDC • List of implemented countermeasure projects for slope disasters risks • Land use regulation for special regime zones for slope disasters risks issued by AMDC		(future activity)	
Project Purpose					
Capacity to manage slope disasters in the Central District is improved.	1. 2 pilot structural measures for small/medium size slope disasters are financed and constructed by AMDC.*3	1. Pilot project review report(s) (including an evaluation of completed construction projects by counterparts) prepared by JICA experts	• The level of importance given to control and mitigation of slope disaster risks by AMDC and the Government of Honduras stays high. • AMDC has access to the equipment and tools owned by UNAH.	Large-scale slope disaster occurred in September 2022 in La Guillen, adjacent to Nueva Santa Rosa, and in June 2024 in Villa Nueva, both of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work and subsequent amendments to the countermeasure plans and designs for both pilot sites. The Important Assumption in the	

[1] Slope disaster means disasters caused by phenomena of slope movements in Spanish.
[2] The Action Plan includes 1) project priorities of area selected by the Project and 2) the AMDC's plan to disseminate the outcomes of the Project.

				PDM has been invalidated. *3 All the parties agreed at the 8th JCC held in March 2025 and signed the minutes, confirming that the essential purpose of the Project is to enhance the understanding of the AMDC, COPECO and UNAH on slope disaster risk reduction against landslides, slope failures, and rockfalls through the process of (i) monitoring, (ii) analysis and diagnosis, and (iii) countermeasure planning. Through the activities implemented under Outputs 1 and 2, the AMDC, COPECO and UNAH have acquired these technical skills in slope disaster management, and therefore it can be concluded that the fundamental purpose of the Project has been achieved. Furthermore, it was recognized that even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that the Project Objective in the PDM has sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and maintenance of structural measures, as well as formulating relevant plans.	
	2. "Action Plan for Risk Reduction for Slope Disasters in the Central District" is created.	2. Document on "Action Plan for Risk Reduction for Slope Disasters in the Central District"		Action Plan and Operational Plan were completed.	
Outputs					
1. Capacity to conduct detailed investigation and analysis to identify and characterize slope disaster phenomena is strengthened.	• Report on detailed investigation and analysis to identify slope disaster risks of pilot sites is produced.	・Report on detailed investigation and analysis to identify slope disaster risks of pilot sites ・JICA project monitoring report ・Manual for investigation and analyzing small/medium size slope disaster risk sites	・The key counterparts are assigned during the project period ・AMDC has access to the equipment and tools owned by UNAH. ・In the pilot site and its surroundings, significant disasters	The report was completed.	
	• A manual for investigating and analyzing small/medium size slope disaster risk sites is prepared.			The manual was completed.	
2. Capacity to design, construct, supervise, and	• 4 structural measures for small/medium size slope disaster risks are constructed. *3	・Project designs of 4 structural measures for small/medium size slopes		As mentioned in the Project Objective above, the essential purpose of the Project is to enhance the understanding of the AMDC,	

maintain structural measures for small/medium size slope disaster risk is enhanced.		・JICA project monitoring report ・4 structural measures at pilot sites ・Manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk	with large-scale topographical alterations does NOT happen during the period from the survey until the countermeasure construction. *3	COPECO and UNAH on slope disaster risk reduction against landslides, slope failures, and rockfalls through the process of (i) monitoring, (ii) analysis and diagnosis, and (iii) countermeasure planning. Through the activities implemented under Outputs 1 and 2, the AMDC, COPECO and UNAH have acquired these technical skills in slope disaster management, and therefore it can be concluded that the fundamental purpose of the Project has been achieved. Furthermore, it was recognized that even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that Output 2 in the PDM has sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and maintenance of structural measures, as well as formulating relevant plans.	
	• A manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risks is prepared.			The manual was completed.	
3. Capacity to develop hazard and risk maps is enhanced	• The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map are created.	・The updated Slope Disaster Hazard Inventory Map and the Multi-hazard Map		The maps were completed.	
	• A manual for hazard and risk mapping is prepared.	・Manual for hazard and risk mapping		The manual was completed.	
4. Capacity to regulate land use for slope disasters is enhanced.	• A draft land use regulation for slope disaster risk area for pilot special regime zones is created.	・A draft land use regulation for slope disasters for pilot special regime zones		The land use regulation was completed.	
	• Land use regulation maps for slope disasters for pilot special regime zones are created.	・Land use regulation map for slope disasters for pilot special regime zones		The land use regulation maps were completed.	

Activities	Input	Pre-condition
1.1. Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters. 1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites. 1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial	Input: Japanese Side 1. Experts 1) Team leader 2) Geological investigation and	Working members are assigned.

information for the terrain elevation model). 1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites. 1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites. 1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas. 1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites. 1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites. 1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites. 1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects. 1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 – 1.9. 1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project. 1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	analysis 3) Topographic survey 4) Structural measures 5) Slope disaster hazard evaluation 6) GIS mapping 7) Land use regulation 8) Coordinator 2. Training in Japan • Training on Slope Disaster Risk Reduction 3. Procurement of Equipment • Digital Terrain Model	
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1. 2.2. Organize applicability of structural measure methods for different slope disasters. 2.3. Conduct the environmental impact/social assessment. 2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC 2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget). 2.6. Conduct bidding and award process 2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works. 2.8. Implement and supervise structural measure works. 2.9. Prepare a monitoring and maintenance plan. 2.10. Conduct monitoring and maintenance of the structural measure works. 2.11. Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 – 2.10. 2.12. Provide training course, seminar, or/and conference to share the manual and experience produced by the Project 2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	<u>Input: Honduras Side</u> 1. Counterpart Personnel: • Project Director (Mayor of AMDC) • Project Manager (Coordinator of UMGIR) • WG members for Output 1 • WG members for Output 2 • WG members for Output 3 • WG members for Output 4 2. Working Space and Facilities for JICA Experts at: • UMGIR • UNAH 3. Project Cost: • Local operation cost • Construction of 2 pilot projects	
3.1. Review slope disaster risk related maps and related information 3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map 3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method. 3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area. 3.5. Collect the existing geo-spatial data in the pilot area. 3.6. Analyze the geo-spatial data in the pilot area. 3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6. 3.8. Define the level of slope disaster hazard and risks in the pilot area. 3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8.		**<u>Issues and Countermeasures</u>**

3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 – 3.9. 3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project. 3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		
4.1. Review the current approach and information on the land use regulation 4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks. 4.3. Select pilot special regime zones to develop a proposal of land use regulation. 4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones. 4.5. Elaborate draft regulations for land use on the pilot special regime zones. 4.6. Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones. 4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District 4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 – 4.6. 4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project. 4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas		

*3: Large-scale landslide disaster occurred in September 2022 in La Guillen, adjacent to Nueva Santa Rosa, and in June 2024 in Villa Nueva, both of the two pilot sites for structural measures financed and constructed by AMDC. The Project period has been extended by two years until December 2025 due to the need for further assessment of emergency work and subsequent amendments to the countermeasure plans and designs for both pilot sites. Even in case that the structural measures in both pilot sites are not completed within the project period, it is interpreted that the Project Objective and Output 2 have sufficiently achieved the Objectively Verifiable Indicators by carrying out technical transfer related to supervision and maintenance of structural measures, as well as formulating relevant plans. The Important Assumption “Significant disasters involving large-scale topographical alterations will NOT occur during the survey and construction period” has been invalidated.

Project Monitoring Sheet II (Revision of Plan of Operation)

Version 11
Dated: October 14, 2025

Project Title: Project for Control and Mitigation of Slope Disasters in the Central District

Inputs	Year	2019	2020	2021	2022	2023	2024	2025	Monitoring: Issue	Monitoring: Solution
Expert										
Team leader / Slope disaster risk analysis	Plan / Actual								No issue.	
Geological investigation and analysis (Landslide)	Plan / Actual									
Structural measures (Landslide)	Plan / Actual									
Structural measures (Slope failure and Rockfall)	Plan / Actual									
Geological investigation and analysis 1 (Slope failure and rockfall)	Plan / Actual									
Geological investigation and analysis 2 (Slope failure and rockfall)	Plan / Actual									
Topographic survey	Plan / Actual									
Construction Planning/Bid Supervision	Plan / Actual									
Construction Supervision	Plan / Actual									
Slope disaster hazard evaluation	Plan / Actual									
GIS Mapping	Plan / Actual									
Land use regulation	Plan / Actual									
Land use regulation 1	Plan / Actual									
Land use regulation 2	Plan / Actual									
Project coordinator/ Training plan	Plan / Actual									
Equipment										
Equipement	Plan / Actual								Completed.	
Training in Japan										
Traning in japan	Plan / Actual								Completed.	

Activities / Sub-Activities	Year	2019	2020	2021	2022	2023	2024	2025	Achievements	Issue & Countermeasures
Output 1:										
1.1 Identify and select pilot sites (2 small/medium-size landslides, 2 small/medium-size slope failures/rock falls, 2 large-size landslides) to implement structural measures on slope disasters.	Plan / Actual								Completed.	
1.2. Prepare Work Plan for the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.3. Investigate the topographic conditions of the 4 small/medium-size slope disaster risk sites (generating geo spatial information for the terrain elevation model).	Plan / Actual								Completed.	
1.4. Investigate the geophysical (elastic wave exploration, electrical exploration, and others) and mechanical (laboratory test and others) characteristics of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								All surveys have been completed.	Monitoring needs to continue.
1.5. Analyze and interpret the data from the investigation of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.6. Evaluate the vulnerability of the 4 small/medium-size slope disaster risks sites, including their surrounding areas.	Plan / Actual								Completed.	
1.7. Define risk and characterize the risk zones of the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.8. Prepare the conceptual proposals of design and inputs required for the structural measures in the Output 2 for the 4 small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.9. Systematize the mechanism and the procedure applied in the characterization process of the 4 pilot small/medium-size slope disaster risk sites.	Plan / Actual								Completed.	
1.10. Prepare project concepts of the 2 large-sized slope disaster risk sites selected in activity 1.1 for future projects.	Plan / Actual								Completed.	
1.11. Prepare a manual for investigating and analyzing small/medium size slope disasters risk sites based on activities 1.1 - 1.9.	Plan / Actual								Completed.	
1.12. Provide training course, seminar, or/and conference to share the manual produced by the Project.	Plan / Actual								Completed.	
1.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	
Output 2:										
2.1. Design structural measure works at the 4 small/medium-size slope disaster risk sites based on the data provided by the Output 1.	Plan / Actual								AMDC is revising the design to incorporate the proposed recommendations of the verification report by JET in Villa Nueva.	
2.2.Organize applicability of structural measure methods for different slope disasters.	Plan / Actual								Completed.	
2.3.Conduct the environmental impact/social assessment.	Plan / Actual								Completed.	
2.4. Assign budget items for the investment for 2 small/medium structural measures conducted by AMDC	Plan / Actual								Since the budget procurement was delayed, the advance payment was disbursed in September 2025.	The initial construction order was issued on September 16, 2025, for both pilot sites.
2.5. Develop bidding documents (technical specification, calculation reports, cost estimation, and estimation of material needed and budget).	Plan / Actual								Completed.	
2.6. Conduct bidding and award process	Plan / Actual								Completed.	
2.7. Make contracts with subcontractors selected in the procurement process to implement the structural measure works.	Plan / Actual								Completed.	
2.8. Implement and supervise structural measure works.	Plan / Actual								The construction supervision plan was prepared, and the construction commenced in October 2025.	While the project concludes, the supervision continue to be duly carried out based on the technologies transferred from JET.
2.9. Prepare a monitoring and maintenance plan.	Plan / Actual								The monitoring and maintenance plans were prepared for the pilot sites	
2.10. Conduct monitoring and maintenance of the structural measure works.	Plan / Actual								A monitoring and maintenance manual was prepared to facilitate technology transfer.	While the project concludes, the monitoring and maintenance continue to be duly carried out based on the technologies transferred from JET.
2.11.Prepare a manual for designing, procuring, constructing, and maintaining small/medium size slope disaster risk sites based on activities 2.1 - 2.10.	Plan / Actual								Completed.	
2.12.Provide training course, seminar, or/and conference to share the manual and experience produced by the Project	Plan / Actual								A technical seminar was conducted to support the supervision and the maitenance.	
2.13. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual								Completed.	

Activity		Issue	Solution
Output 3:			
3.1. Review slope disaster risk related maps and related information	Plan / Actual	Completed.	
3.2. Identify and select a pilot area to update the Slope Disaster Risk Hazard Inventory Map and the Multi-Hazard Map	Plan / Actual	Completed.	
3.3. Prepare check sheets for simple hazard/risk evaluation at field visits and organize the simple hazard/risk evaluation method.	Plan / Actual	Completed.	
3.4. Investigate the slope disaster conditions at field visits with the check sheets in the pilot area.	Plan / Actual	Completed.	
3.5. Collect the existing geo-spatial data in the pilot area.	Plan / Actual	Completed.	
3.6. Analyze the geo-spatial data in the pilot area.	Plan / Actual	Completed.	
3.7. Interpret the results of the field visits in activity 3.4 and the geo-spatial data analysis in activity 3.6.	Plan / Actual	Completed.	
3.8. Define the level of slope disaster hazard and risks in the pilot area.	Plan / Actual	Completed.	
3.9. Update the Slope Disaster Risk Hazard Inventory Map and Multi-Hazard Map in the pilot area for integrating SIMET based on the prioritization in activity 3.8	Plan / Actual	Completed.	
3.10. Prepare a manual for hazard and risk mapping based on activities 3.1 - 3.9.	Plan / Actual	Completed.	
3.11. Provide training course, seminar, or/and conference to share the hazard map produced by the Project.	Plan / Actual	Completed.	
3.12. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas.	Plan / Actual	Completed.	
Output 4:			
4.1. Review the current approach and information on the land use regulation	Plan / Actual	Completed.	
4.2. Define scope of work for land use regulation of special regime zones for slope disaster risks.	Plan / Actual	Completed.	
4.3. Select pilot special regime zones to develop a proposal of land use regulation.	Plan / Actual	Completed.	
4.4. Prepare technical materials based on Output 3 for explanation of land use regulation of the pilot special regime zones.	Plan / Actual	Completed.	
4.5. Elaborate draft regulations for land use on the pilot special regime zones.	Plan / Actual	Completed.	
4.6.Prepare land use regulation map indicating the zoning for the regulation on the pilot special regime zones.	Plan / Actual	Completed.	
4.7. Submit the draft regulations and the draft land use regulation map to the Municipal Corporation of the Central District	Plan / Actual	Completed.	
4.8. Prepare a manual for land use regulation of slopes disaster based on activities 4.1 - 4.6.	Plan / Actual	Completed.	
4.9. Provide training course, seminar, or/and conference to share the draft/approved regulation produced by the Project.	Plan / Actual	Completed.	
4.10. Prepare the Action Plan for Risk Reduction for Slope Disasters in prioritized areas	Plan / Actual	Completed.	

Monitoring Plan	Year: 2019 – 2025 (months 1–12)	Issue	Solution
Monitoring			
Joint Coordinating Committee	Plan / Actual	The final JCC meeting is held in October 14. 2025.	
Submission of Monitoring Sheet	Plan / Actual		
Reports/Documents			
Work Plan	Plan / Actual	Completed.	
Progress Report	Plan / Actual	Completed.	
Final Report	Plan / Actual	Draft final report was submitted on October 2025.	Final report will be submitted on December 2025.

Appendix 2

Learning materials at home

Agencia de Cooperación International del Japón

Honduras
Proyecto para el Control y Mitigación de Desastres en Laderas del Distrito Central

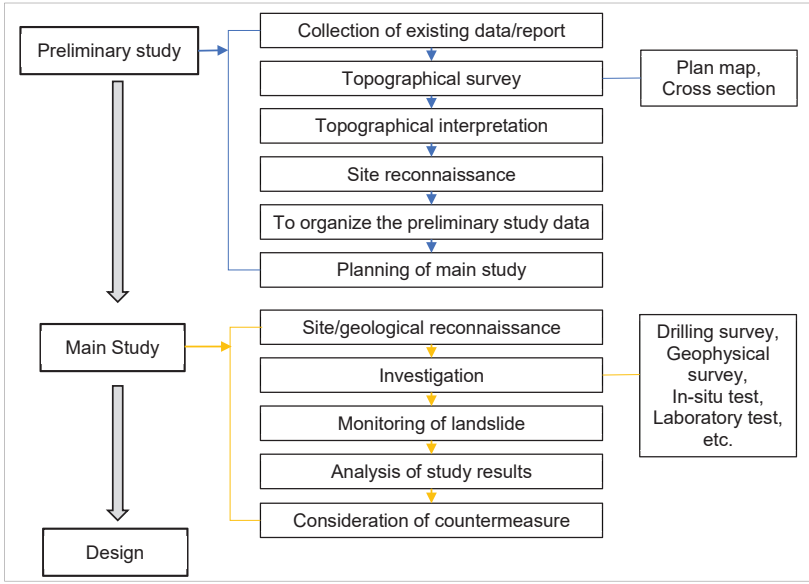
[Materiales de aprendizaje en casa]

Resultado 1: Se fortalecen las capacidades para realizar investigaciones y análisis detallados para identificar y caracterizar fenómenos de desastres en laderas

Junio, 2020

Table of Contents

1. Flow of study on landslide



【Points of this term】

- The above the flow shows the procedure for implementing permanent measures for landslides. Note that this is different from the case of emergency measures taken immediately after a landslide disaster.
- As soon as the target area for landslide countermeasures has been determined, a topographic survey plan should be created based on the initial site visit results, and the work of creating plan map and cross-sections drawings in an appropriate range should be performed. The drawings are a fundamental data of all works.
- It is better to obtain satellite images and/or aerial photographs taken in past of the site before conducting the site reconnaissance. The data helps you understand the site situation.
- It is advisable to conduct the site reconnaissance with the survey drawings. At this stage, the shape and extent of the landslide block(s) is assumed roughly.
- To organize the collected data up to this stage and make the main/detail study plan.
- To organize the main study results and build a landslide model. If there are any uncertainties when building the model, supplementary study is conducted accordingly.
- To analysis to estimate the mechanism of landslide occurrence in the target area. Perform stability analysis, verify the mechanism of occurrence, and set the ground constant of the landslide block.
- Based on the estimated mechanism, countermeasure is considered.

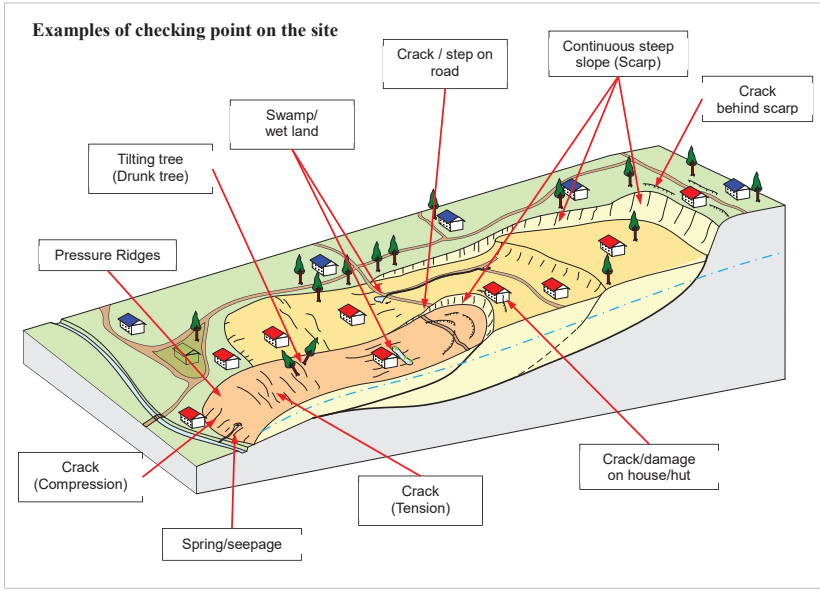
2. Collection of existing data

Type	Material	Remarks
Map/ Drawings	Topographical map	Contour map in any scale
	Geological map	In any scale
	Satellite images	Ex: Google Earth. Several years data
	Aerial photo	Before and after disaster
	Land usage map	The latest version
Report/ Document	Disaster record	Date, time, damages, area, precipitation etc. CODEM /COPECO
	Land inspection record	GER
	Construction record	Road, buried object/lines, countermeasure, structure, etc. on/around landslide area
	Technical report	Existing study/investigation done on the area
Data	Precipitation data	Hourly/daily precipitation
	DEM data	If available

【Points of this term】

- It is important to collect existing data before conducting a field work. It is useful to understand the site situation by grasping in advance and to work effectively.
- Topographic maps are useful for understanding site topographical condition and landslide feature. Topographic map in small scale is useful at the existing data collection.
- The geological map can be used to find out the distribution of geology that is prone to landslides, the structure of the stratum, and the existence of faults.
- Satellite image and aerial photos can be used to interpret topographic features such as faults, anomalies, and past landslides. In addition, if there are photographs taken before and after the landslide, it can be assumed the area where the landslide occurred and the extent of damage.
- The land usage map shows what kind of land use is done in/around the landslide area. Land usage conditions may also contribute to the occurrence of landslides.
- Disaster records not only in the target area but also in neighboring areas can be used to identify the characteristics of the disaster occurrence. Check the data by CODEM and COPECO.
- If there is a result of GER's investigation for land use permit, that information also helps to grasp the site situation.
- Recent construction work on/around the landslide area may have changed the surrounding topographic conditions. It is good to know where the work was done.
- If a site survey or countermeasure work has been performed after the landslide, obtain the technical report. Past survey results and survey items are useful in planning future surveys.
- Many cases of landslide occurrences are related with rainfall. Therefore, hourly and daily rainfall data for one week before and after the landslide occurrence is obtained.

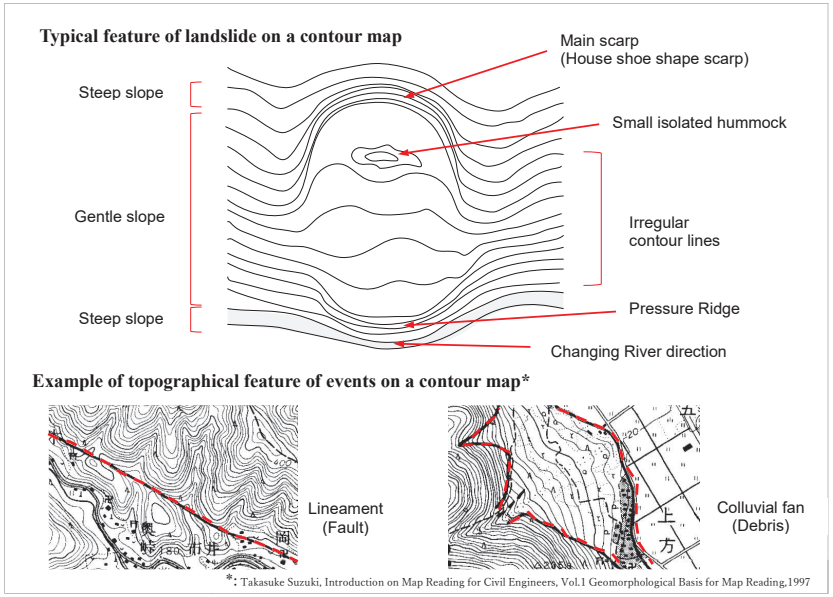
3. Site reconnaissance 1



【Points of this term】

- It is more efficient to carry out the site reconnaissance with the topographical survey drawings such as contour map and sectional drawings after confirming the existing data.
- At the site, to confirm the location and status of topographic changes and structural damage that are presumed to be caused by landslides, road deformation, and spring water and so on. The information obtained on the site is described on the map or drawings.
- To check not only the location of crack, but also an extension direction and presence of step. The crack direction is changed depending on a part of the landslide block.
- Local residents are most aware of site changes and disaster situations. Be sure to conduct interviews with them.
- If there is a case of landslide or slope failure in the neighboring areas, check them. There may be similarities in disaster types and characteristics.
- Conducting the reconnaissance with applicable countermeasure in mind is to clarifies the points to be confirmed on the site.
- The scarp is a place where you can directly observe the geological condition of the landslide block.
- To identify an area of the landslide block by the reconnaissance.
- If study was conducted on the site before, the condition and circumstance of the location where the investigation/survey conducted in the existing study is confirmed.

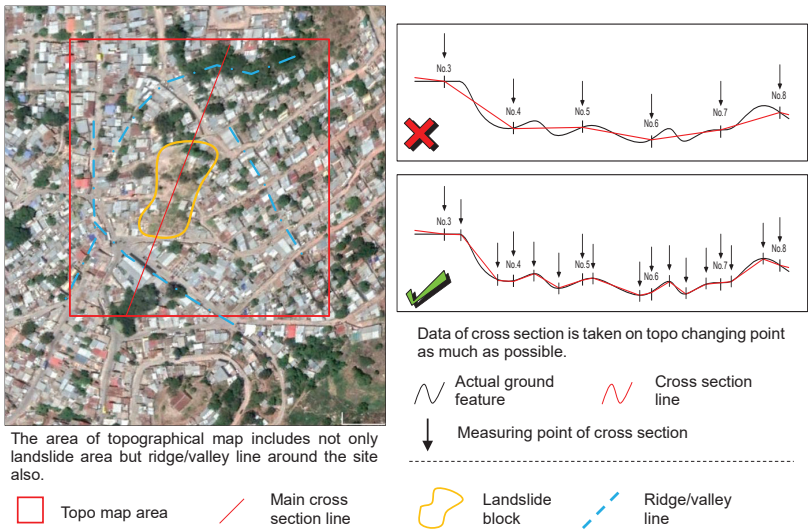
4. Topographical Interpretation



【Points of this term】

- The topographic interpretation contributes to identify the landslide area on the map. Places where landslides occurred in the past often show characteristic topography of landslide.
- The area where a landslide was estimated to have occurred in the past by topographical interpretation is not necessarily the landslide area. Conduct site survey at that location to confirm whether the landform is due to a landslide.
- In case of old landslide, main scarp may not be clearly shown due to an erosion.
- Topographic interpretation can be performed using not only contour map but also satellite image or aerial photo. By observing these photos with a stereoscope, the landslide topography can be identified more easily.
- If you use a satellite image browsing service (Google Earth, etc.), you can browse the data taken in the past, and check the topographic changes in a time series.
- Contour lines on landslide area are often more disturbed than the lines around the area.
- Landslide may be the cause of sudden changes in direction of road and/or river.
- From topography, large-scale topographic structures such as geological types and properties, faults and folds can be estimated.
- Once the contour map of the target area has been created, the topographic interpretation is performed before conducting the site survey. The site survey is conducted with the map shown the interpretation results.

5. Range and position of plan map and sectional map



【Points of this term】

- Topographic survey data are fundamental data to properly perform future works, so the survey range and the position of cross section must be carefully determined.
- Especially, the plan map (contour map) is useful for inferring the topographical changes and the shape of landslides, so the topographical irregularities should be displayed as much as possible. Contour lines is drawn at 1 – 2 m intervals.
- It is advisable to widen the range of the plan map not only to the expected landslide block but also to the transformation point of the terrain. It is possible that the landslide was larger than the expected range during the site investigations. In addition, the range of the plan map is determined in consideration of the transportation route of materials and equipment for the countermeasure work.
- The survey area is also determined by referring to the results of the initial site visit, aerial photos and satellite images.
- In the cross-sectional view, the main survey line is the line that passes through the center of the assumed landslide block and runs along the maximum slope direction. In case of compound landslides, take main survey line in each block.
- For the cross-section survey, measure each transformation point of the terrain and display the terrain shape as finely as possible.

6. Investigation methods

	Item	Purpose
Geological survey	Site reconnaissance	To obtain information of topographical, geological and surface conditions, and information of existing facilities on/around the site.
Geotechnical survey	Drilling survey	To obtain information of geological condition underground of the site, and core samples.
	Standard penetration test	To obtain N-value to estimate property of the underground material.
Geophysical survey	Seismic refraction survey	To estimate thickness of loosen layer, condition of fracture zone, location of fault, etc.
	Electrical resistivity survey	To estimate distribution of loosen layer, moisture condition of the ground, and distribution of groundwater table, etc.
	Electrical resistivity logging	To estimate distribution and variation of aquifer
Monitoring survey	Inclinometer	To confirm movement and depth of slip surface
	Extensometer	To confirm movement of ground surface
	Groundwater measurement	To confirm variation of groundwater table
Laboratory test	Physical test	Unit weight, Plastic / liquid limit, etc.
	Direct shear test	To estimate the shear strength of slip surface. Undisturbed sample is used for the test.
	Triaxial compression test	

【Points of this term】

- The investigation method is selected according to the site situation and the purpose of the survey.
- Basically, a drilling survey should be conducted. At least two borings are planned on the main survey line. If it is difficult to identify the landslide area, drilling is conducted outside the expected landslide area.
- When using the borehole for landslide monitoring, the position of the drilling survey should be determined in consideration of availability of the monitoring.
- The drilling depth is planned to be 5m or deeper than the expected slip surface. Alternatively, the borehole bottom should be the same as or lower level than the toe of landslide.
- It is desirable to conduct a standard penetration test (SPT) at the same time as the drilling survey. The sample of SPT enables observation of the geological condition, and depending on the type of test, it can also be used as a specimen for laboratory tests.
- In the landslide survey, seismic refraction survey and electrical resistivity survey are mainly performed. The drilling survey is planned on the lines of the survey, the results of the boring survey can be reflected in the analysis of the geophysical survey result.
- Landslide monitoring can be used not only for surveys but also for safety management during construction work and maintenance management after construction work.

7. Site reconnaissance 2

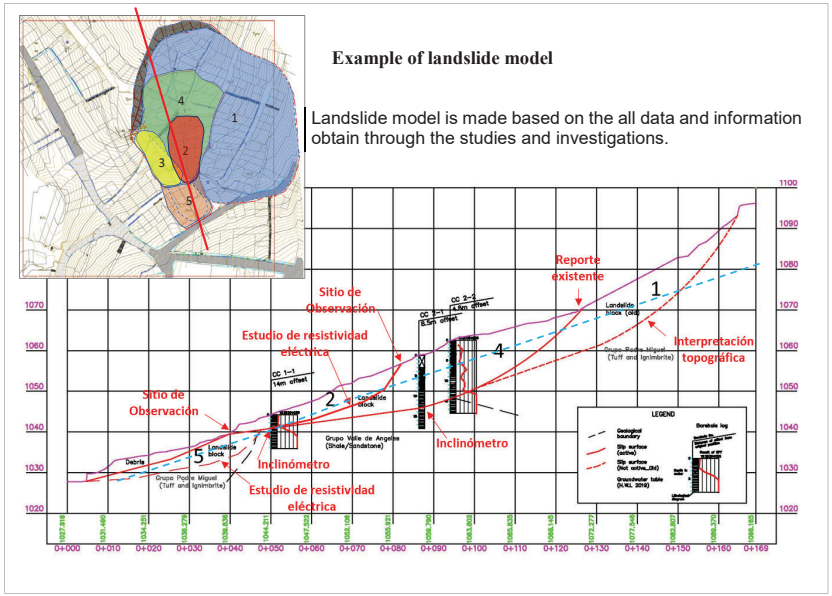
Information obtained from the reconnaissance

Topography	Slope feature	Height, angle, sectional shape
	Topo feature	Talus deposit, terrace shape, hill, etc.
	Abnormality	Overhanging, outcrop, knick line, etc.
	Disaster	Landslide, debrsi flow, collapse
Geology	geology	Geological strata, rock condition
	Crack	Fault, fracture zone, joint, bedding
	Structure	Dip and strick, folding, etc.
	Weathering	Weathering, alteration, strength,
	Unconsolidated deposit	Material, clasification, thickness
Surface	Rocks	Size, distribution, instability
	Vegetation	Type, density, growing
	Spring	Existance, condition
Existing facility	Type	Countermeasure, road, house, etc.
	Scale	Height, length, fanction
	Deformation	Crack, lifting up, gap, etc.

【Points of this term】

- The site reconnaissance is performed to comprehend condition of topography, geology, soil, springs, vegetation, land use and disasters due to landslides in a wide range of areas including the target landslide block, and to confirm the survey results and problematic points for implements countermeasures.
- Wide scale of topographical information can be grasped more comprehensively from aerial photos and satellite images. However, micro-topography, deformation of the ground surface, and areas covered by vegetation should be confirmed on site.
- Since it is highly possible that groundwater is involved in landslide activities, information on spring water or leakage from pipes is obtained on the site.
- If possible, the entire situation of the target area can be grasped by carefully observing from the opposite bank of the landslide site before conducting a survey within the landslide site. Also, it is useful to observe the landslide slope from various angles such as from the side.
- Deformation of existing structures is important information for estimating the direction, activity and extent of landslides.
- It is important to find outcrops in order to understand the geological condition. An outcrop can be seen on a steep cliff formed by a landslide.
- Areas where the growth of vegetation is not good are often slopes where disasters are likely to occur.

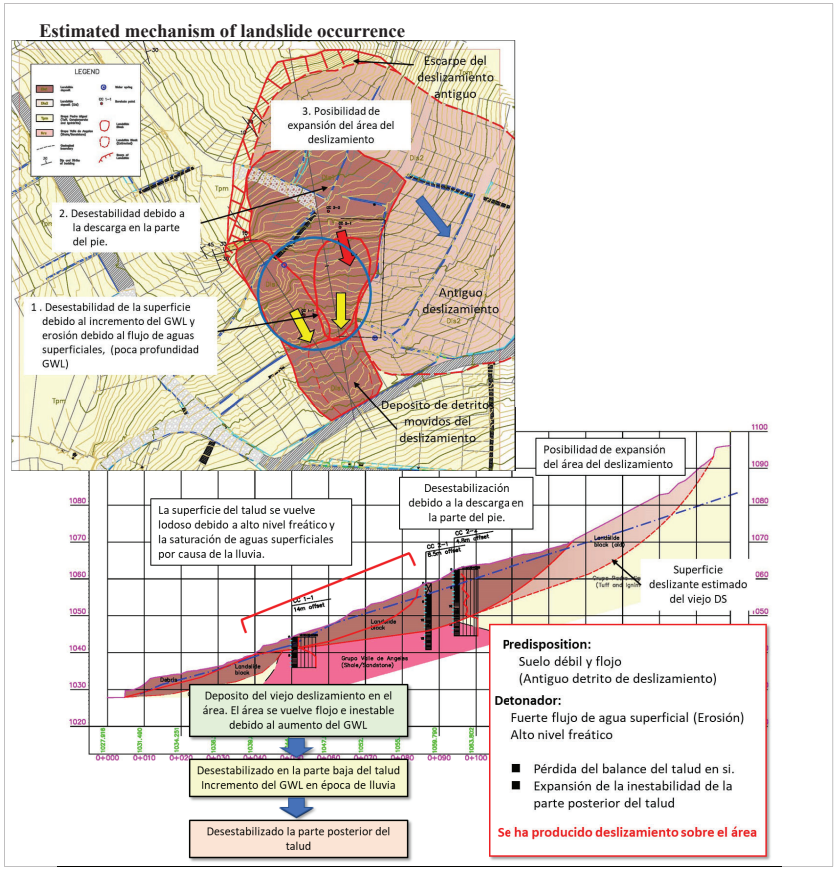
8. Landslide analysis (Landslide model)



【Points of this term】

- To make a landslide model based on the conducted survey and existing survey results. The landslide model shows the slip surface shape, groundwater table, and geological information.
- The slip surface often has a plane parallel to the ground surface. If the clear slip surface cannot be confirmed from the survey results, the slip surface may be estimated from the shape of the ground surface.
- To make sure that the landslide model is created with multiple cross sections and that all cross sections have no discrepancies and consistency is ensured. When a landslide model is studied with only one cross section, there is a possibility that it is inconsistent with the slip surface shape of other cross sections.
- Since the landslide model is used as a calculation model for stability analysis and also for studying countermeasure works, the landslide model should be prepared by sufficiently reflecting the survey results. The cross section used for stability analysis and examination of countermeasure works is created by the main survey line that passes through the center of the target landslide and is parallel to the slope direction (direction of landslide activity).
- Monitoring results are mainly used for the slip surface depth and groundwater level on the landslide model. Monitoring is continued even after the landslide model is prepared, and if new data is obtained from the monitoring results, it is necessary to examine the contents and make appropriate corrections.

9. Landslide analysis (Mechanism of landslide occurrence)



【Points of this term】

- The mechanism of landslide occurrence is the work of estimating the cause of landslides. Estimating the mechanism is important for clarifying the problem location and factor and considering appropriate countermeasures against it.
- To estimate the predisposition and trigger in considering the mechanism of landslide occurrence. These are estimated from the site conditions, the rainfall conditions, the order of damaged part, and the results of the monitoring.
- When there are multiple landslide blocks, it is important to estimate the landslide block that is the first starting block and to clarify the most active landslide. It is also necessary to estimate the sliding direction of each landslide.

10. Stability analysis (Methodology)

Fellenius (Ordinary) method

Fs = shear strength / shear stress = S/T

T = $W \cdot sin\alpha$

S = $[W \cdot cos\alpha - ul] \cdot tan\varphi + cl$

Where,

Fs = Factor of safety

W = weight of slice – kN/m^3

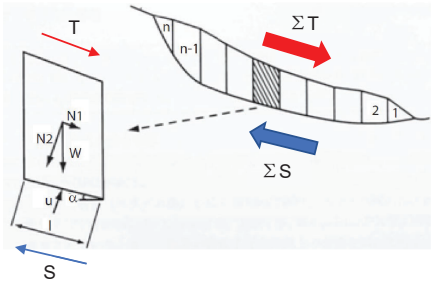
c = cohesion intercept – kN/m^2

φ = internal friction angle – degree

u = pore pressure – kN/m^2

α = angle between base of slice and horizontal – degree

l = length of slip surface segments measured along base of slice – m



【Points of this term】

- Stability analysis is performed by using the landslide model created on the main survey line.
- If S (shear strength) and T (Shear stress) are the same, the safety factor is 1, and it is considered as an equilibrium state. If T is larger than S, the safety factor becomes less than 1, and it is determined as unstable state. On the contrary, if the safety factor is 1 or more (S is larger than T), it is in a stable state.
- For stability analysis of landslides, a slice method is used, in which the landslide mass is divided into several slices. The shear strength and shear stress of landside is sum of shear strength and shear stress of all slices.
- The slice is divided at each point where the angle of the slip surface or the ground surface changes.
- A number of stability analysis methods have been proposed and each has its own characteristics. Among them, stability analysis formulas such as Spencer method and Morgenstern & price method, which are closer to exact solutions, have been proposed, but they are rarely used in practical cases in Japan.
- The Fellenius method is relatively used in Japan to take measures against landslides. Since the main purpose of stability analysis in landslide project is to confirm the effectiveness of the countermeasure work to be applied, the method that is easy to calculate is often applied.

11. Stability analysis (Setting of parameters)

Requested parameter and data for a stability analysis

Main Parameter	Target	How to obtain
Unit weight	Each geological layer	Laboratory test
Cohesion	Slip surface	Laboratory test, estimated based on the thickness of the landslide body
Internal friction angle	Slip surface	Laboratory test, estimated by Back analysis method
Groundwater table	Whole area	Groundwater level measurement, estimated by electrical resistivity survey.

Block sampling

Laboratory test
(Direct shear test)

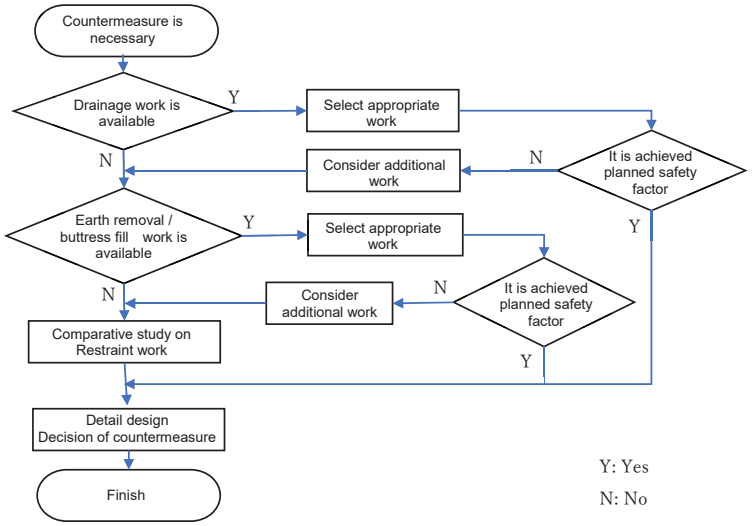
Groundwater
measurement pipe

【Points of this term】

- It is necessary to set the required parameters for stability analysis.
- In principle, parameters obtained by laboratory tests and site tests are applied. However, regarding the shear strength of the slip surface, it is difficult to obtain parameters by laboratory tests because it is difficult to collect undisturbed samples on the slip surface.
- If the shear strength of the slip surface cannot be obtained by laboratory tests, there is a way of estimating the shear strength from other ground constants (e.g. N-value and physical test values). In Japan, empirical values of cohesion may be used based on the estimated thickness of the landslide block.
- In Japan, the back analysis method is used for estimating the shear strengths. This is a method of setting the cohesion first and estimating the internal friction angle indicating a preset safety factor according to the actual site condition.
- Even though an undisturbed sample of the slip surface is collected, and stability analysis is performed using the shear strength obtained from the laboratory test, the safety factor may not match the actual situation at the site. This is because the actual properties of the slip surface are diverse, and the collected sample is only data at one point of the entire slip surface.
- It is necessary to repeat trial calculation with trial and error in order to set the parameters that match the actual situation at the site.

12. Concept of selection of countermeasure

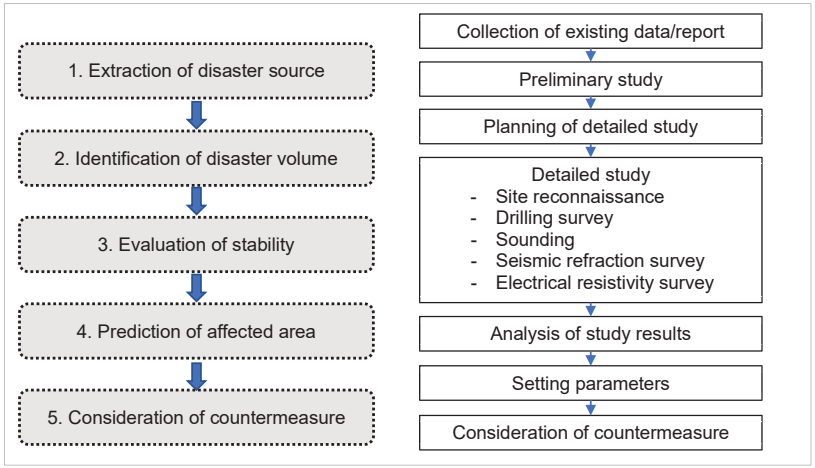
Flow to select countermeasure work for landslide



【Points of this term】

- If it is confirmed that rainfall and landslide activity are closely related, surface drainage work is applied.
- Groundwater includes shallow groundwater table that flows through aquifers in colluvial soil and deep groundwater table that is artesian groundwater in the basement rock below the slip surface. The type of countermeasure differs depending on the groundwater.
- Discharge of shallow groundwater is the main countermeasure for landslide that consists of weathered clayey materials. In the case of landslide that consists extremely soft cohesive soil, the landslide is stabilized gradually by groundwater drainage work at the upper slope to prevent the inflow of groundwater into the landslide block.
- If the slip surface of a single block has an obvious arc shape, earth removal work at the head part and deep groundwater drainage work would be effective.
- If there are multiple landslide blocks and the shape of the slip surface is close to a straight line, the buttress fill work and groundwater drainage work at the end would be effective, but earth removal work may be not effective relatively.
- Restraint work would be effective in preventing small-scale landslides.
- Restraint work for large-scale landslides require a large resistance force, so they are often used as an abandonment of multiple countermeasures works.

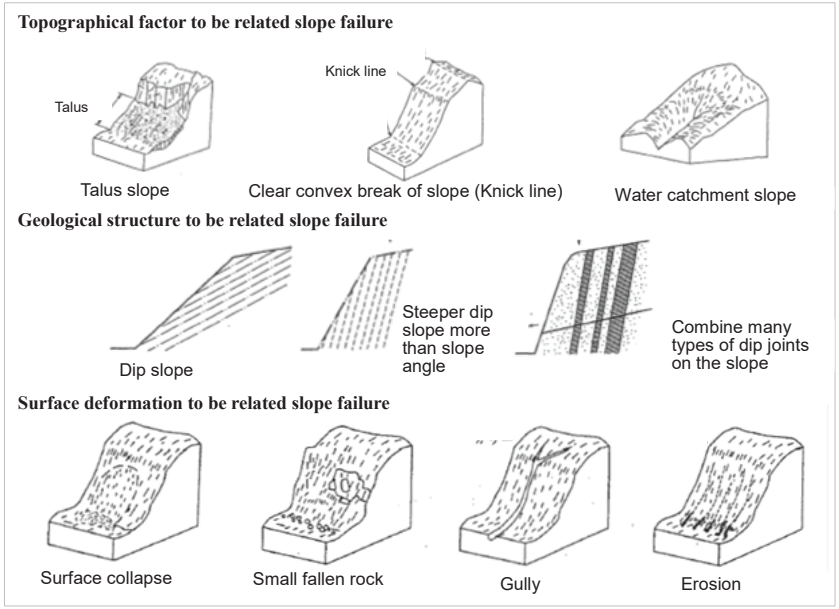
13. Flow of study on slope failure and rock fall



【Points of this term】

- The final purpose of the study is to consider proper countermeasures for slope failure and rockfall.
- 1) Disaster sources are extracted for the targeted disaster, 2) the volume is identified, 3) the current stability of the target is evaluated and 4) areas to be affected and to be protected are predicted for 5) consideration of countermeasure (Above left flow).
- The above right flow shows the procedure for implementing permanent countermeasures for slope failure and rockfall.
- Before the site investigation, existing data/reports are collected and verified to understand. The method of the activity is referred in “2. Collecting of existing data” of “Landslide” (p. 2).
- To grasp the site condition roughly, reconnaissance is conducted with the survey drawings. Disaster source, volume and its stability are estimated based on the observation at the site.
- After the reconnaissance, the items, quantity, location and procedure on the detailed study are planned. The method of the planning is referred in “5. Range and position of plan map and sectional map” of “Landslide” (p. 5).
- Detailed study is, for example, mainly consisted of site reconnaissance, drilling survey, sounding, seismic refraction survey, electrical resistivity survey to evaluate the stability of the area.
- The results of study are analyzed to decide the mechanism and stability.
- Based on the study results and the analysis results, parameters of soils and rocks are discussed and determined to decide the method and quantity of countermeasures.
- Countermeasures are considered from the scale and the affected areas for the targeted disaster.

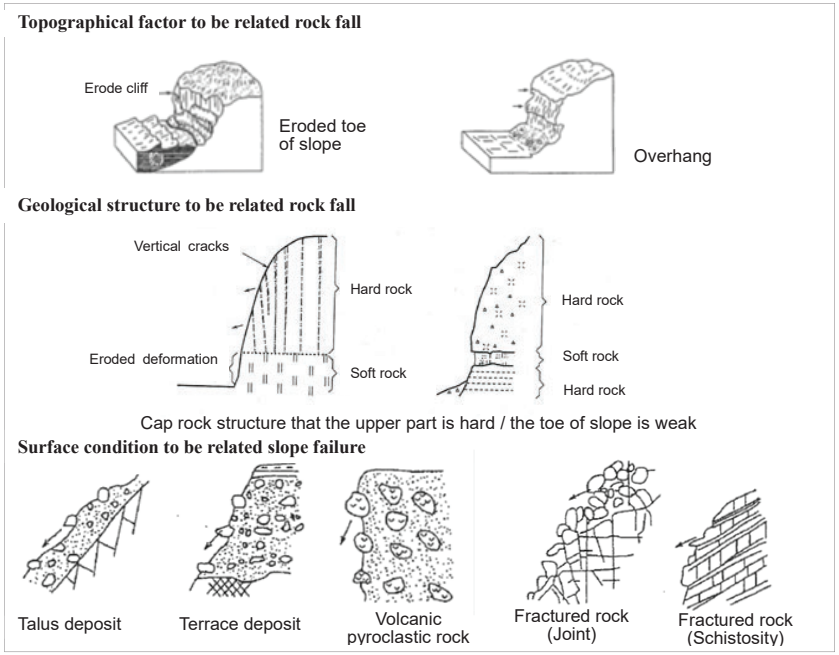
14. Preliminary study (Slope failure)



【Points of this term】

- Topographic map, geological map, satellite images (ex. Google Earth) are useful to understand overall condition of the targeted area and rough volume of the disaster, Especially, geology that is prone to erode and/or scrape is estimated with geological maps and its reports.
- Disaster records and construction records clarify the type and scale of slope failure in the past, and are effective to estimate the mechanism and affected area of failure. If possible, precipitation data when the slope failure happened in the past are useful to estimate them.
- Reconnaissance is conducted to investigate topography, geology, soil condition, surface water condition, vegetation, land use and buildings to be protected. The length, width, depth, weathering, alteration, cracks, steps, cliff, deposit and current countermeasures are checked for possible slope failures at the site.
- For topographical factors, talus slope (fallen debris from upper part, and generally consists of gravely soil and is loose condition), knick line (clear convex break of slope, which is front line of erosion and collapse) and water catchment slope are paid attention to.
- For geological structure, dip slope of bedding plane is paid attention to, which is easy to be collapsed.
- For surface deformation, small collapse, fallen rocks, gully (V shape erosion by water) and erosion are paid attention to, which are mainly triggered of slope failure with surface/ground water.

15. Preliminary study (Rock fall)



【Points of this term】

- Topographic map, geological map, satellite images (ex. Google Earth) are useful to understand higher part of outcrops and the surrounding area, Especially, geology that is boundary between hard rock and soft rock would be a cliff or a steep slope.
- Disaster records and construction records clarify the type and volume of rock fall in the past, and are effective to estimate the mechanism and affected area of possible rock falls.
- Reconnaissance is conducted to investigate topography, geology, outcrop condition, vegetation, land use and buildings to be protected. Unstable rocks, fallen rocks, cracks, old failure, unconsolidated layer, bare land, ridge and current countermeasures are checked for possible rock falls at the site.
- For topographical factors, eroded toe (the part of the slope which faces curved river line is eroded by river flow) and overhang (more than 90 degree of slope angle) are paid attention to.
- For geological structure, cap rock structure is paid attention to, which is easy to be collapsed.
- For surface condition, talus deposit, terrace deposit, volcanic pyroclastic rock and fractured rock are paid attention to.

16. Investigation methods

Investigation method \ Points to be checked		Soil condition (type, strength, tightness)	Rock condition (type, strength, weathering, cracks)	Geological structure				Strength of base rock	Small collapse, small fallen rock	Surface/Ground water condition
				Fault, fracture zone, dip slope	Cracks, fissures	Weathering, alteration	Thickness of colluvial soil/ talus deposit			
Geological survey	Site reconnaissance	XX	XX	XX	XX	X	X		XX	XX
Geotechnical survey	Drilling survey	XX	XX	X	XX	XX	XX	X		X
	Sounding (Cone penetration test)	X	X			X	X	X		
Geophysical survey	Seismic refraction survey	X	X	X	X	X	X	X		
	Electrical resistivity survey	X	X	X		X	X			X

XX: Frequently used method, X: Used method

【Points of this term】

- Detailed site reconnaissance is useful to check the current condition and to evaluate the stability of slope failure and rock fall, which reveals soil/rock condition and geological structure as well as surface water condition.
- Drilling survey and sounding, for slope failure, are conducted inside and outside of the possible failure to evaluate the stability and failure scale and to confirm the tighten layers for countermeasures. In case of large slope failure, several drillings and soundings are desirable. The depth of the borehole should be to reach below (a few meters) the base (little weathering) layer. The sounding is useful for steep slopes where it is difficult to conduct the drilling survey.
- Drilling survey and sounding, for rock fall, are conducted at the lower talus slope of the possible rock fall to confirm the tighten layers for countermeasures. In case of wide range area of rock fall, several drillings and soundings are desirable. The depth of the borehole should be to reach below (a few meters) the base (little weathering) layer.
- Seismic refraction survey and electrical resistivity survey are conducted at the possible slope failure or rock fall to evaluate the stability. They are also conducted at the lower talus slope to confirm the tighten layers for countermeasures. Survey lines are should be covered the possible disaster area for the analysis, and the countermeasure area for the plan of it.
- In this Project, monitoring and laboratory test are not conducted for slope failure and rock fall. However these methods could be effective to consider the stability and to discuss the countermeasures (referred in “6. Investigation methods” of “Landslide” (p. 6)).

17. Detailed study (Slope failure)

Information obtained from the detailed survey

Study item		Check points
Failure source	History of failure	Frequency/scale/range of past failure
	Estimated failure source	Height, falling velocity
	Estimated scale of failure	Width, length, depth
	Material of slope	Type, strength, tightness
Slope condition	Angle	Angle of slope
	Sectional shape	Ridge, valley, convex, concave, straight
	Vegetation	Type, height, density (bear land, grass land, trees)
	Facility	Existing countermeasure, its effectiveness
Lower part	Location	Clearance between slope and targets to be protected
	Ground strength	Type, strength, tightness (from sounding, SPT, etc.)
	Target to be protected	Road, house, public facility, etc.

【Points of this term】

- Preliminary study is composed of the existing data collection and the preliminary site reconnaissance, and detailed study is the geotechnical survey, the geophysical survey and the detailed site reconnaissance.
- The purpose of the detailed study is to organize the information for planning and designing of countermeasures. Engineering judgement is important to decide various condition of the disaster based on the observation and the survey results.
- The type and mechanism of targeted slope failure are examined. Large scale failure is mainly controlled by geology and geological structure, and small scale (surface) failure tends to be controlled by topographic condition and surface condition of the slope.
- Since water condition would be a trigger of slope failure, surface/ground/spring water should be paid attention to. In addition to gully and erosion on the surface, water catchment slope and permeable/impermeable layers should be identified. The leakage of sewer which would be a trigger of slope failure is checked around the slope.
- Type, weathering, alteration of soil/rock are estimated with the observation of core sampling with the drilling survey, and strength and tightness under the ground is also identified with the sounding.
- Seismic refraction survey and electrical resistivity survey would reveal the thickness of soft layers and weak zone such as weathering or fracture.
- The results of geotechnical survey and geophysical survey are not necessarily matched; therefore they should be reviewed and adjusted with the observation of site reconnaissance. Based on the review of these study and survey, geological map and geological cross section are prepared, and the stability and the affected area of slope failure are evaluated.

18. Detailed study (Rock fall)

Information obtained from the detailed survey

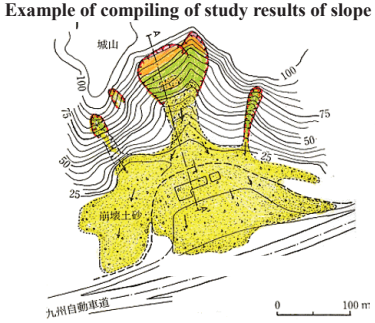
Study item		Check points
Rock fall source	Position, distribution	Height, location, quantity
	Size	Maximum side, diameter
	Shape	Round, sub-round, square, columnar, flat
	Unit weight	(Decision from laboratory test)
	Hardness	Hard rock or soft rock with hammering
	Degree of instability	Open cracks, restraint condition
Slope condition	Undulation	Step, changing of angle, conversion point
	Vegetation	Type, height, density (bear land, grass land, trees)
	Sectional shape	Ridge, valley, convex, concave, straight
	Angle	Angle of slope
	Height	Height of slope
Geological condition	Direction of crack	Fault, bedding, discontinuity, weathering
	Density of crack	Average, maximum density
	Openness of crack	Width and its continuity
	Hardness of slope surface	Rock type, weathering (from drilling log, geophysical survey)
	Strength of slope	Type, strength, tightness (from sounding, SPT, etc.)
Lower part	Location	Clearance between slope and targets to be protected
	Ground strength	Type, strength, tightness (from sounding, SPT, etc.)
	Target to be protected	Road, house, public facility, etc.

【Points of this term】

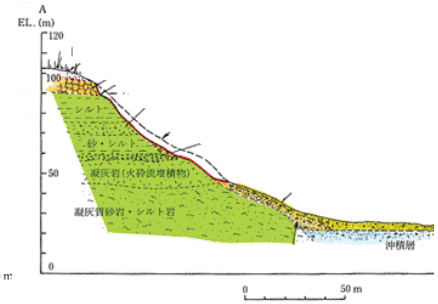
- The detailed study is conducted to understand the type, scale, fallen route, mechanism, stability of the targeted rock falls and the physical property value such as base slope.
- Fallen rocks at the lower part of the slope would be an evidence of size, shape, hardness of possible rock falls. The affected area of rock fall would be predicted from the location of the fallen rocks. Therefore, the current condition of fallen rocks should be closely checked and described on a plan map (scale=1:100～1:1,000).
- Unstable rocks and detached rocks would be future rock falls. In order to identify these rocks, direction/density/openness of cracks, weathering condition and looseness are checked on the rock slope.
- The drilling survey and the sounding are conducted to understand the strength and tightness under the ground on the lower slope for planning and designing of countermeasures in this project.
- Seismic refraction survey and electrical resistivity survey would reveal the thickness of weak layers such as weathering and the fracture/crack zone at the rock slope.
- The results of geotechnical survey and geophysical survey should be reviewed and adjusted with the observation of site reconnaissance.

19. Analysis of study results (Slope failure)

Example of compiling of study results of slope failure

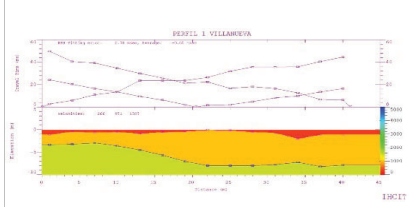


Geological map

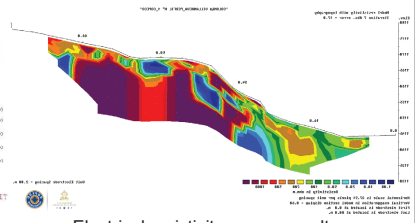


Geological cross section

Source: http://www.nan9.co.jp/2016/ghazard/sakusa.htm



Profile created by seismic refraction



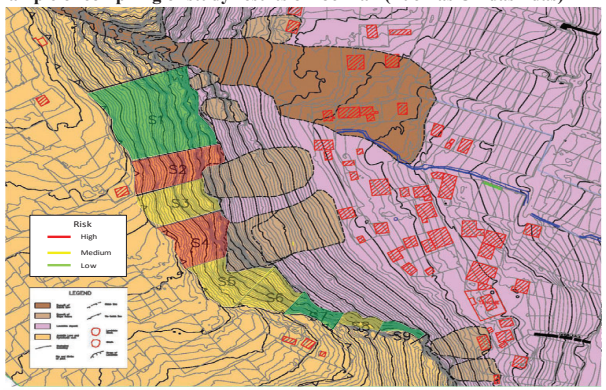
Electrical resistivity survey result

【Points of this term】

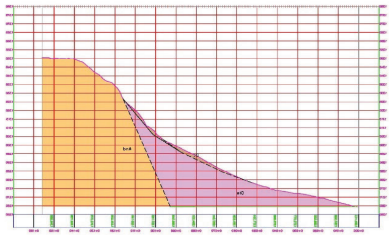
- Topographic features, geology, surface water condition, vegetation and building location which have been obtained the study at the site are compiled on a geological map and a geological cross section.
- Based on P wave velocity (km/sec), which is lower for loosen/cracked layer and higher for hard rock, from seismic refraction survey, layers and their thickness are estimated in the ground. Generally, it is divided into surface soil, unconsolidated layer, highly weathered base rock and base rock from the top.
- Based on electrical resistivity, which is lower for clayey/high moisture/fractured layer, distribution of weathering and cracked area is estimated in the ground. However soil condition should be discussed with consideration of the results of the seismic refraction survey and the site reconnaissance.
- Location and scale (length, width, depth) of possible failure are estimated the site condition and the geophysical surveys, and are also described on the map and the cross section with the failure-related features such as faults, cracks and weathering area.
- If possible, failure route on the slope and the affected area are predicted and drawn on the map and the cross section.

20. Analysis of study results (Rock fall)

Example of compiling of study results of rock fall (Fuerzas Unidasnidas)



Geological map and result of risk assessment



Geological cross section

Section	Instability	History	House	Risk rank
1	Low	N	N	III
2	High	Y	Y	I
3	Low	N	Y	II
4	High	Y	Y	I
5	Low	Y	Y	II
6	Med	N	Y	II
7	Low	N	Y	III
8	Med	N	Y	II
9	Med	N	N	III

Table of risk assessment

【Points of this term】

- Type of rock, location (distance, height) and scale (length, diameter) of possible rock fall are estimated at the site reconnaissance.
- If the rocks are countable, they are described on the geological map and the geological cross section. Rock fall route on the slope and the affected area, which may be altered by topography and vegetation, are predicted and drawn on the map and the cross section.
- If there are numerous rocks in the area, it is recommended that the area is divided into several sections, and risk for rock falls is analyzed for each section.
- In this project, indicators to be assessed for the risk are three, 1) looseness of rock slope (the quantity of unstable/detached rocks), 2) past history of rock falls and 3) existence of houses to be protected in each section. The overall risk is classified into three level, high, middle, and low, by the combination of the three indicators. The policy of countermeasure is different on each risk level.
- Fallen rocks in the talus deposit at the lower part could be re-moved downward due to erosion of the deposit by heavy rainfall. The hazard and risk of the fallen rocks are also considered.

21. Setting parameters (Slope failure)

General parameter and condition to be required for design

Parameter and condition	Method
Scale and location	Estimation at site
γt: Unit weight	Laboratory test [reference: gravel 1.8-2.0, gravel with sand 1.9-2.1, sand 1.8-2.0, sandy soil 1.7-1.9, cohesive soil 1.6-1.8 (kN/m^3)]
σ_c: Uniaxial compressive strength	Laboratory test or estimation from P wave velocity [Vp (km/s)] on seismic refraction survey σ_c (Mpa) = Vp^3 (km/s) (Mpa=1,000 kN/m^2)
$\emptyset$: Internal friction angle	Laboratory test or estimation from N value which is calculated by cone penetration test $\emptyset = \sqrt{15N} + 15$ (degree)
c: Cohesion	Laboratory test or estimation by Back Analysis method
P_{max}: Collision impact value	$P_{max} = \gamma t \cdot V^2 \cdot A \cdot \sin^2 \alpha$ (kN) γt: Unit weight I (t/m^3) *V*: Velocity of collision (m/s) *A*: Projected area on the object when debris collides the object (m^2) α: angle for the object when debris collides the object (degree)
V: Velocity of collision	$V = \sqrt{2g(\sin\beta - \frac{c}{\gamma t \cdot g \cdot h})L}$ (m/s) *g*: Gravity acceleration (m/s^2) β: Angle of slope (degree) *c*: Cohesion (kN/m^2) γt: Unit weight (kN/m^3) *h*: thickness of failure debris (m) *L*: Length that failure debris moves (m)

【Points of this term】

- In order to design countermeasures effectively, parameter and condition should be set as accurate as possible. Scale and location of targeted slope failure are basic information to set the parameters accordingly.
- Unit weight is estimated in laboratory test, but it is not easy to get accurate value. Generally, reference values based on past experience are applicable.
- Uniaxial compressive strength, internal friction angle and cohesion are estimated in laboratory test, but they are also difficult to get it. Conversion formulas from other values (seismic refraction survey or sounding etc.) and Back Analysis method are useful.
- Collision impact value and velocity of collision are calculated by the values that are estimated from site reconnaissance and laboratory test, and used for design of restraint works of slope failure.

22. Setting parameters (Rock fall)

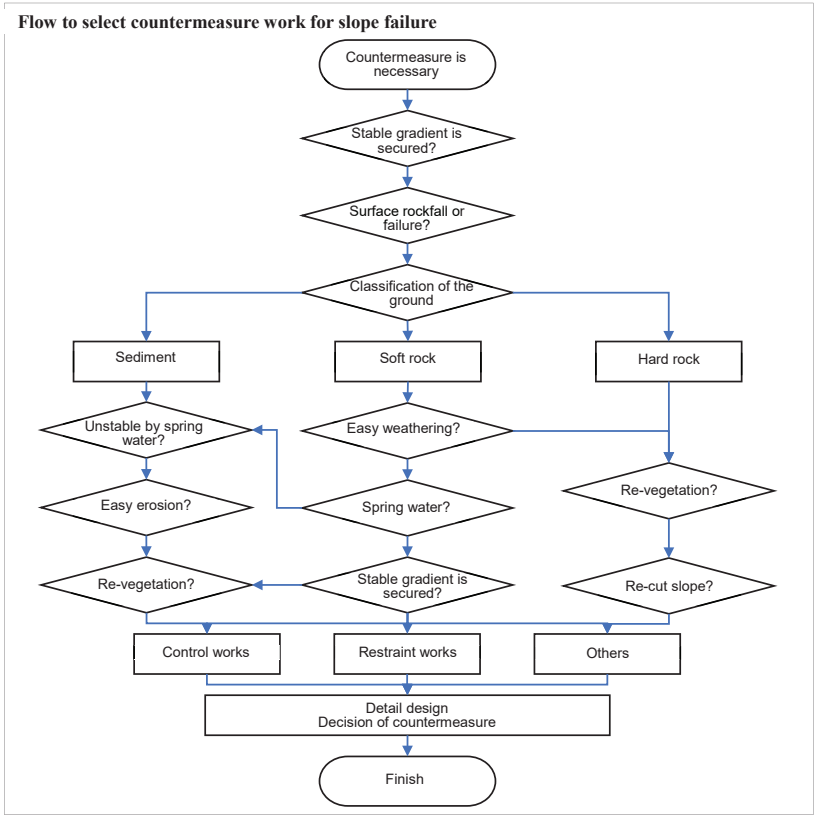
General parameter and condition to be required for design

Parameter and condition	Method
Scale of rock fall	Estimation at site
Route of rock fall	Estimation at site
H: Hight of source of rock fall	Estimation at site
γ: Unit weight of rock	Laboratory test [reference: andesite 2.2-2.9, tuff 1.8-2.6, basalt 2.7-3.2, sandstone 2.2-2.7, granite 2.5-2.8 (kN/m^3)]
V: Velocity of rock fall	$V = \sqrt{2g(1 - \mu/\tan\theta)H}$ (m/s) *g*: Gravity acceleration (m/s^2) μ: Equivalent friction coefficient of slope θ: Angle of slope (degree) *H*: Hight of source of rock fall (m)
μ: Equivalent friction coefficient of slope (Selection among right values based on the features of rock fall and slope)	0.05: rounded hard rock, even slope, no tree 0.15: rounded- angulated soft rock, uneven slope, no tree 0.25: rounded- angulated rock, debris even slope, no tree 0.35: angulated rock, debris uneven slope with boulders, trees
Height of rock jumping	Less than 2 meters in almost cases
P_{max}: Collision impact value	$P_{max} = 2.108(mg)^{2/3}\lambda^{2/5}H^{3/5}$ (kN) m: Weight of rock fall (t) *g*: Gravity acceleration (m/s^2) *H*: Height of source of rock fall (m) λ: Lame constant of object to be collided (kN/m^2) [object: very soft=1,000; soft=3,000-5,000; hard=10,000]

【Points of this term】

- Scale and route of rock fall are fundamental condition to design countermeasure and are estimated by observation at the site reconnaissance. Route of rock fall could be calculated with a rock fall simulation software in Japan, but modeling, setting parameters and calculation method should be thoroughly verified for the simulation, and its application is limited.
- Unit weight of rock is estimated laboratory test, but it is not easy to get accurate value. Generally, reference values based on past experience are applicable.
- Calculation formula of the velocity of rock fall is derived from several experiments in Japan. Equivalent friction coefficient is set with consideration of shape of fallen rock, surface condition of slope, undulation of slope and density of tree.
- Collision impact is critical value for design of protection works of rock fall, which is calculated by weight and height of rock fall and coefficient for hardness (Lame constant).
- Uniaxial compressive strength and unit weight of the talus deposit at the lower part for countermeasure design are referred “21. Setting parameters (Slope failure)”(p.21).

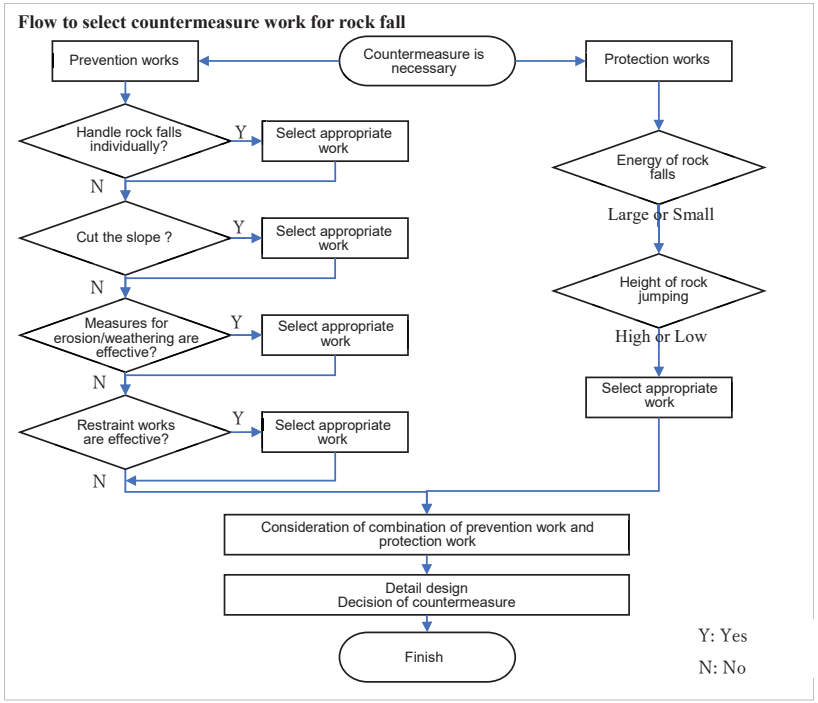
23. Concept of selection of countermeasure (Slope failure)



【Points of this term】

- Countermeasure for slope failure is composed of control works, restraint works and others. Control works are countermeasures to alleviate the impact of surface/ground water. Restraint works are countermeasures to prevent the failure by changing the ground balance in the slope. The other is, for example, a retaining wall.
- Stable gradient of the slope and surface condition (small rock falls/failure) are considered first to decide the countermeasure method. In addition, the method depends on the classification of the ground (sediment, soft rock, hard rock).
- Control works, restraint works and others are selected with the consideration of spring water, erosion, weathering and angle of the slope, and with the possibility of re-vegetation and re-cutting slope.

24. Concept of selection of countermeasure (Rock fall)



【Points of this term】

- Countermeasure for rock fall is composed of prevention works and protection works.
- Prevention works are countermeasures for unstable rocks and detached rocks at the source on the slope, such as removal or fix of the rocks that may fall. The purposes of prevention works are 1) to prevent weathering and/or erosion that would be triggers of rock fall, and 2) to prevent happening of rock fall.
- Protection works are countermeasures to capture falling rocks and to reduce their energy between the source of rockfall and the object to be protected, such as wall, net, fence etc. The purposes of protection works are 1) to absorb the energy of falling rocks, 2) to lead them to harmless direction, and 3) to stop them.
- Based on comparison and combination, both prevention works and protection works should be examined simultaneously.
- For prevention works, the possibly of individual measure, cut slope, erosion/weathering of the slope and restraint works such as crib works and anchoring should be discussed to decide the method.
- For protection works, energy of rock falls and height of rock jumping should be examined.

Agencia de Cooperación International del Japón

Honduras
Proyecto para el Control y Mitigación de Desastres en Laderas del Distrito Central

[Materiales de aprendizaje en casa]

Resultado 2: Se fortalecen las capacidades para el diseño, construcción, supervisión y mantenimiento de las medidas estructurales de atención ante riesgos de desastres en laderas de pequeña/mediana escala.

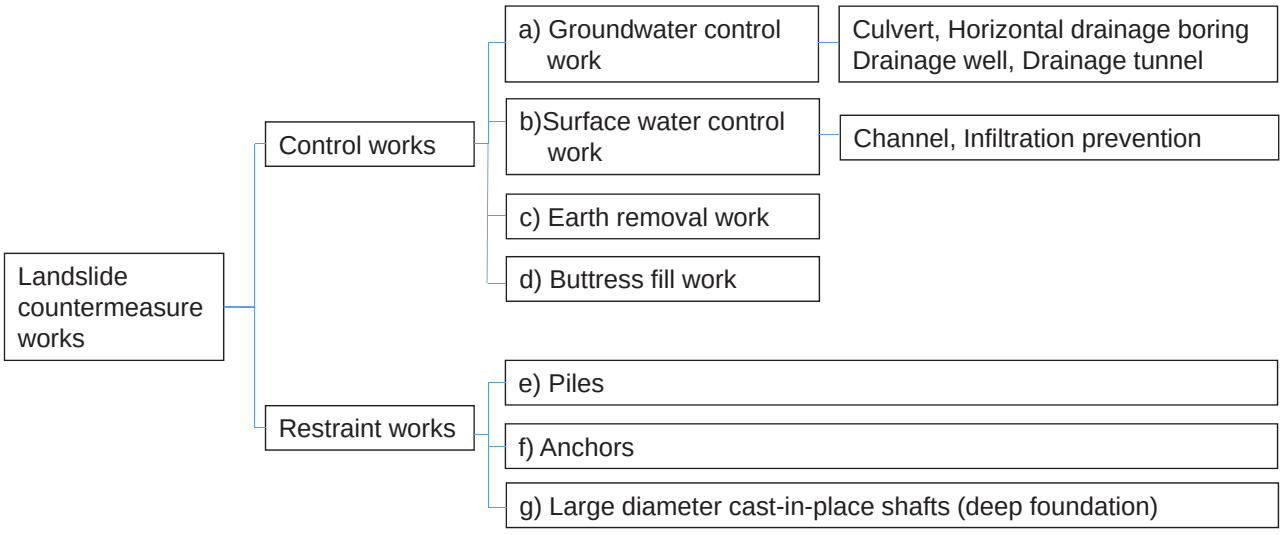
Junio, 2020

Landslide

＜Table of contents＞

1. Introduction of landslide countermeasure works

1.1 Classification of landslide countermeasure works



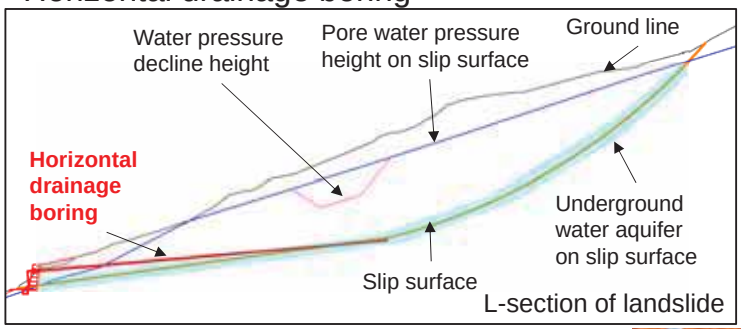
Landslide countermeasure works are divided into Control works and Restraint works.

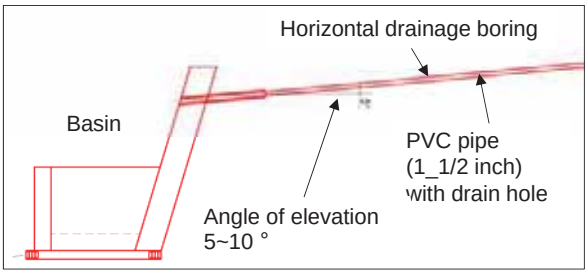
Control work is a method to stop or mitigate the landslide movement by improving the balance of sliding force and resistance force of the landslide by changing the natural conditions such as the topography of the landslide site and the state of groundwater.

Restraint work is a method of stopping part or all of the landslide activity using the resistance force of the artificial structure.

1.2 Control works : Ground water control work

<Horizontal drainage boring>





Drilling situation

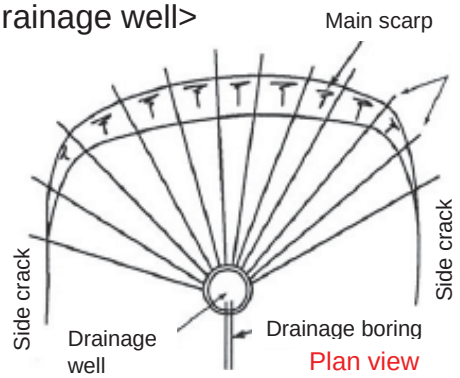
Borehole top (Drainage situation)

Horizontal drainage boring reduce the pore water pressure acting on the slip surface and the water content of the landslide mass by inserting strainer-processed retaining pipes into the boring holes that are made slightly upwards, thereby eliminating groundwater.

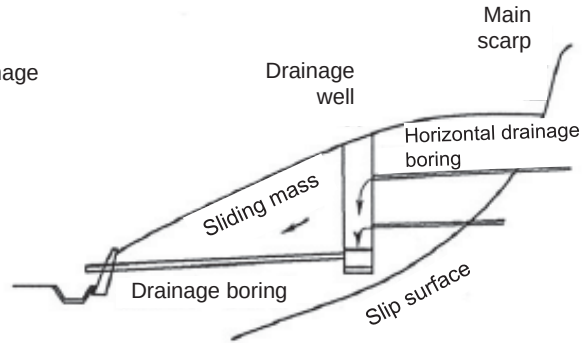
Therefore, in order to effectively lower the groundwater level, the best effect is obtained by designing the aquifer distribution and groundwater fluidized bed not only in the landslide area but also in the surrounding topography and geology and groundwater surveys, etc. when designing.

It is necessary to decide the position, number, direction and extension of the boring so that the water can be collected normally.

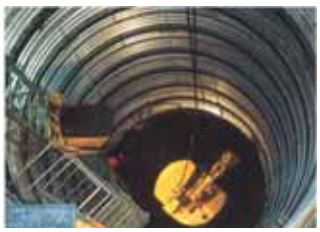
<Drainage well>



Plan view



L-section



Drainage well excavating situation

Drilling situation

Exterior

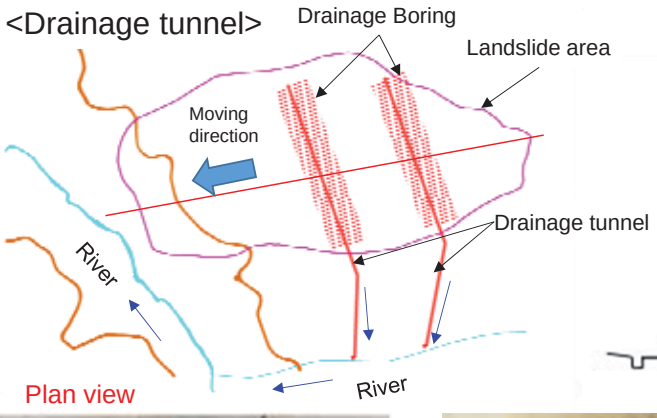
Water collecting situation

Drainage well is a method of excavating a well for water collection, and is used when intensively collecting groundwater at a deep slip surface position or when the extension of horizontal boring from the ground is too long.

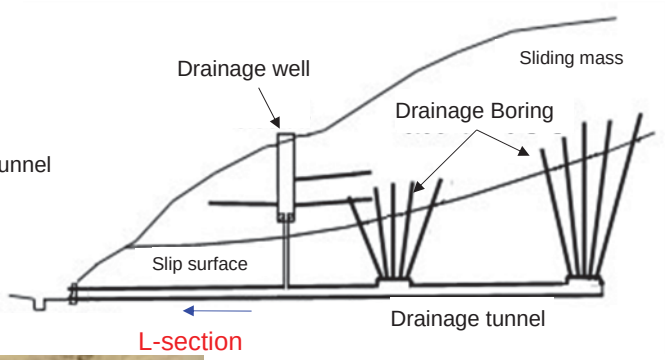
Drainage well is a circular well with diameter of 3.5 to 4.0 m, and the focus is on the water collecting effect from horizontal drainage boring inside the well, but in order to obtain the water collecting effect of the well itself, water collecting holes may be provided on the wall of the well.

Since there are multiple groundwater aquifers in the moving layer, it is possible to plan the collection of water from the well by arranging it in multiple stages so that the groundwater in the groundwater aquifers directly related to the slip surface can be efficiently collected.

<Drainage tunnel>



Plan view



L-section

Inside the tunnel

Drilling(drainage boring)

Drainage situation

Drainage tunnel is planned, when the scale of the landslide is large or the moving layer thickness of the landslide is large, and when it is difficult to obtain the effect only with the drainage well and horizontal drainage boring .

The drainage tunnel is designed so that groundwater that affects the slip surface can be effectively drained by setting drainage boring from the tunnel or connecting to drainage well.

In principle, the location of the tunnel should be within the immovable ground, and the distribution of groundwater veins that affect the landslide and the efficiency of the groundwater drainage effect against it should be determined comprehensively.

1.3 Control works : Surface water control work

<Channel work>

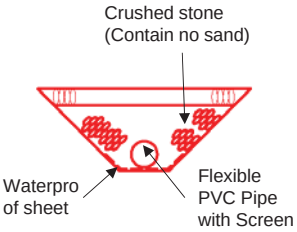
Concrete channel

Soil bag channel

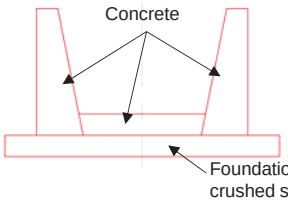
Corrugated steel material channel

Fabric formwork made channel (It's possible to make free form)

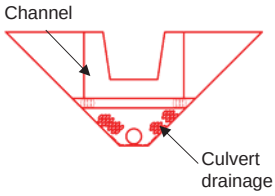
Culvert drainage



Culvert drainage



Concrete channel



Channel with Culvert drainage

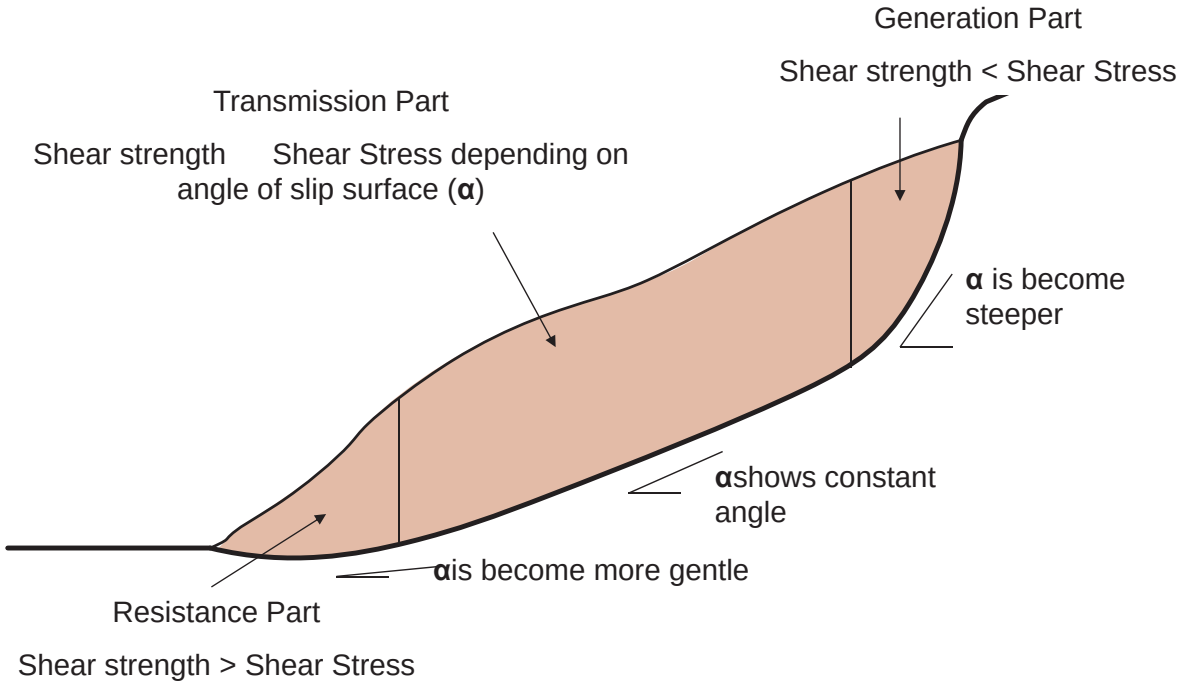
Channel is a construction method aimed at remove surface water to outside of landslide. Culvert drainage that removes the groundwater in the very shallow layer, which is often installed in combination with the flume, is also shown here.

Landslides are often generated by water such as rainfall and snowmelt. Channel is a method to quickly remove surface water such as rainfall and snowmelt from the landslide.

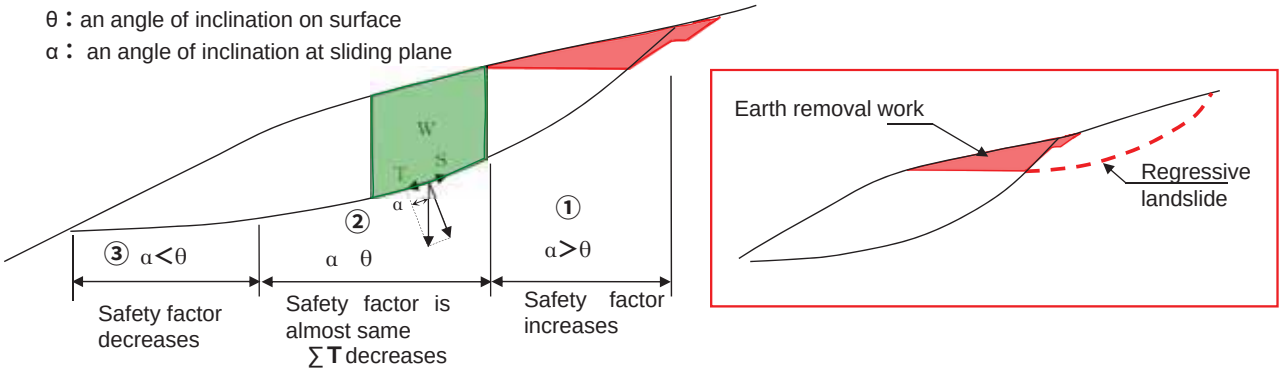
Culvert drainage is installed to remove shallow groundwater and seepage water.

There are concrete, and corrugated steel material, soil bag, mortal concrete with fabric formwork and others used. They are selected depend on slope situation.
In addition, in some cases, we may create a unlined channel.(Emergency temporary construction)

1.4 Control works : Earth removal work



It can be divided into at least 3 parts on this landslide.
The angle of the slip surface differs depending on the part, and the slope stability properties differ.



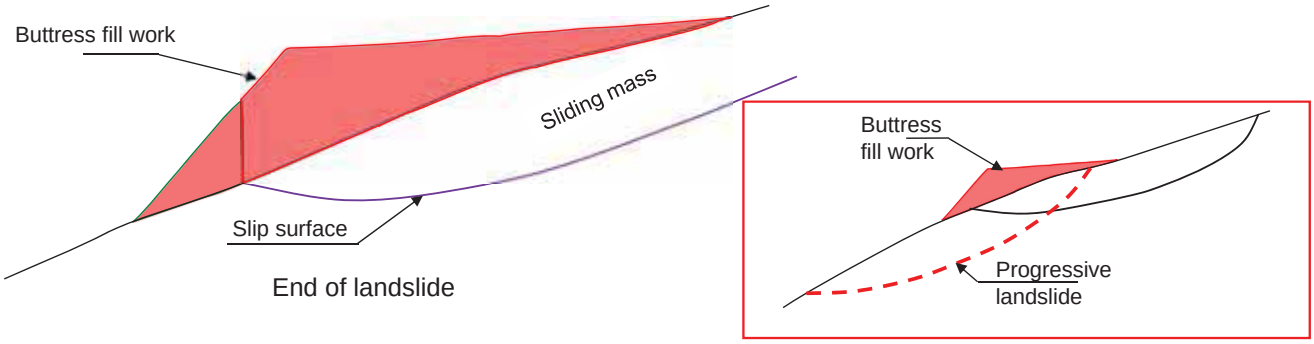
Earth removal work help the landslide mass to remove the sliding moment
Earth removal work→ sliding moment：T （=W･sinα）decrease
resistant moment：S （=W･cosα×tanφ'）decrease

The effectiveness differ on each location
①Top : good : Safety factor increases, T＞S on each slice
②Middle : not good : Safety factor is almost same, T S on each slice
③End : bad : Safety factor decreases, T＜S on each slice

The effect of earth removal work depends on the location.
As shown in the figure, it is effective for landslide top where the slip surface slope is steep.
On the contrary, it is not preferable at the end of landslide where the slope of the slip surface becomes gentle, as it reduces stability.

When earth removing, it is important to care of the slope stability upper the landslide.
For earth removing, the safety factor is improved by removing a large amount of soil on the top of landslide, but the risk of regressive landslide is increase.

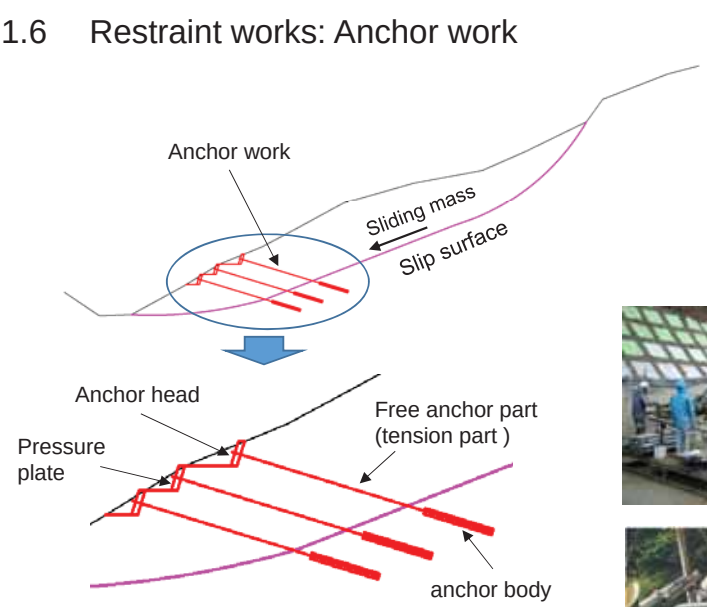
1.5 Control works : Buttress fill work

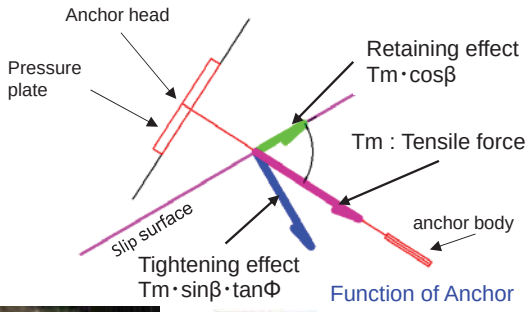


The end of the landslide where the slope of the slip surface becomes gentle is part with resistance for landslide.
Filling in this part increases the stability of the landslide.

When Filling, it is important to care of the slope stability under the landslide.
For Buttress filling, the safety factor is improved by filling a large amount of soil at the end of landslide, but the risk of progressive landslide is increase.

1.6 Restraint works: Anchor work

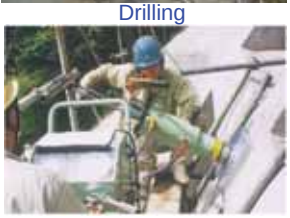




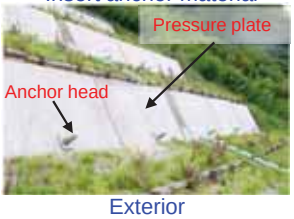
Function of Anchor

Drilling

Insert anchor material



Tension work



Exterior

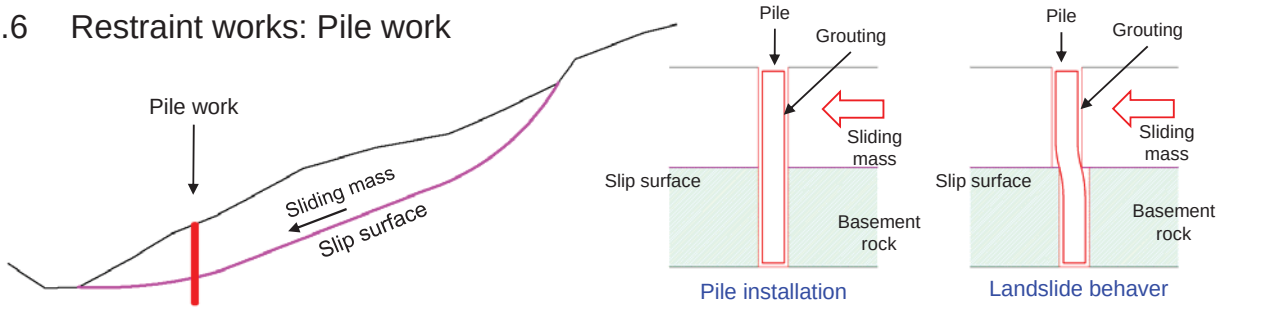
Anchor work is a construction method that attempts to counter the landslide sliding force by utilizing the tensile strength of the steel material that has settled by grouting in the basement rock layer.

It is a construction method in which the reaction force structure and the ground are integrated and stabilized by transmitting the load acting on the anchor head to the anchor body(anchorage ground) via the tension part.

Tensile force acts as a retaining and tightening effect and resists landslide.

Anchor consists of three components: anchor head (including pressure plate), free anchor part(tension part) and anchor body.

1.6 Restraint works: Pile work



Large diameter cast-in-place shafts (deep foundation)

Pile work is a construction method in which a steel pipe or H-steel is inserted into a large-diameter boring hole that is drilled vertically from the ground surface to the basement rock below the slip surface and the filling grout makes it adhere to the ground.

When the landslide moving layer is displaced for some reason, the pile deforms and resists to landslide.

Pile work is designed to add resistance to shearing and bending by inserting piles to the basement rock, and to directly resist the sliding force of the landslide.

Steel pipe piles are often used. Recently, large-diameter steel pipe piles with diameter of more than 1000 mm have also been used, and it is possible to deal with the case where the required landslide prevention force is large.

If the landslide scale is large and the thrust is difficult to suppress with piles such as steel pipe piles, Large diameter cast-in-place shafts (deep foundation) is planned.

Large diameter cast-in-place shafts (deep foundation) excavates a vertical shaft with a diameter of 3.0 to 6.5 m in the landslide ground to the basement rock using a liner plate, etc.,

Then It's assembled a cylindrical shape rebar in the vertical shaft and it's poured concrete. It is constructed as a reinforced concrete column.

2. Planning of landslide countermeasure works

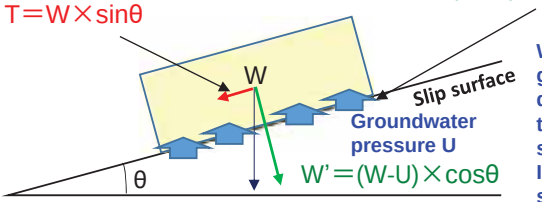
2.1 Safety factor

Along the slip surface sliding power

$T = W \times \sin\theta$

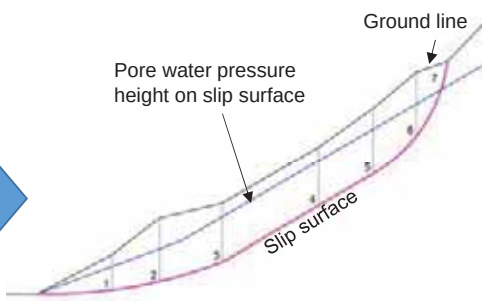
Slip surface strength to resist slip

$S = C' + (W-U) \cdot \cos\theta \cdot \tan\varphi$



When the amount of groundwater increases due to rainfall, etc., the strength against slippage decreases, Imbalance and cause sliding.

In the above formula "U" increases and the resistance decreases.



Evaluate the stability of the entire slope by summing up the calculations (1-7 in the above figure) for each slice.

The safety factor is evaluated based on the balance between

Slip surface strength to resist slip (S) and

Sliding power along the slip surface (T).

$$F = S/T$$

When evaluating the stability of landslides, the concept of safety factor is used. The safety factor is a balance ratio between the force of slipping along the slip surface and the strength of the slip surface resisting the slip. (See above figure)

When the sliding force and the resistance are equal, the safety factor F = 1.00 is evaluated.

Depend on underground water situation and slide situation safety factor always changes.

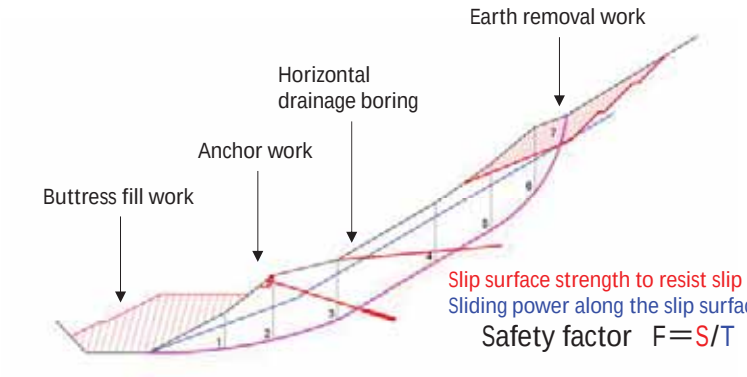
Also, if landslide activity is recognized, it is evaluated as F < 1.00, if landslide is stopped, it is evaluated as F > 1.00.

For general landslide prevention work, the "Current safety factor" is set to 0.95 to 1.00 according to the current sliding condition.

The landslide occurrence / movement mechanism, the importance of the maintenance target, the expected degree of damage, and other considering the above, the "Planned safety factor (P.Fs)" is set to 1.10 to 1.20.

In addition, the planned safety factor (P.Fs) of 1.05 or more shall be set even if the immediate safety is to be secured by emergency measures.

2.2 Planning of countermeasure works and setting of safety factor



Current safety factor	F0 = 0.98
Safety factor before Earth removal work	F1 = 1.00
Safety factor before Buttress fill work	F2 = 1.02
Safety factor before Horizontal drainage boring	F3 = 1.05
Safety factor before Anchor work Planned safety factor	P Fs = 1.10

The effect of landslide countermeasure work is evaluated as follows when calculating the safety factor.

○Groundwater control work (Horizontal drainage boring, Drainage well, tunnel) : Because the pore water pressure is reduced, the value of U is reduced and the value of S (Slip surface strength to resist slip) is increased, then safety factor is increased.

○Earth removal work : The soil mass on the landslide top which has a large sliding force is removed, so the value of (T) is reduced, and the safety factor is increased.

○Buttress fill work : Since soil is filled up at the landslide end where the resistance to slip is large, the value of (S) is increased and the safety factor increases.

○Restraint works (Anchor, Pile) : Depending on strength of the structure, value of (T) is reduced or the value of (S) is increased ,and safety factor is increased.

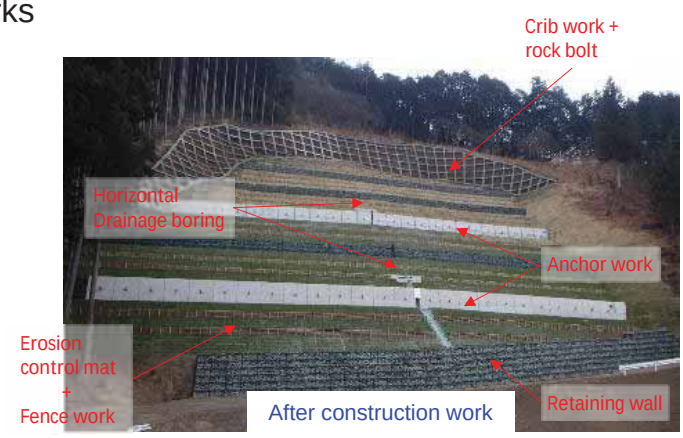
Landslide countermeasure works are planned by effectively combining these measures according to the nature and scale of the landslide and the target of conservation.

The plan of countermeasure work is planned so that the effect of each countermeasure work is accumulated and the target safety rate can be secured.

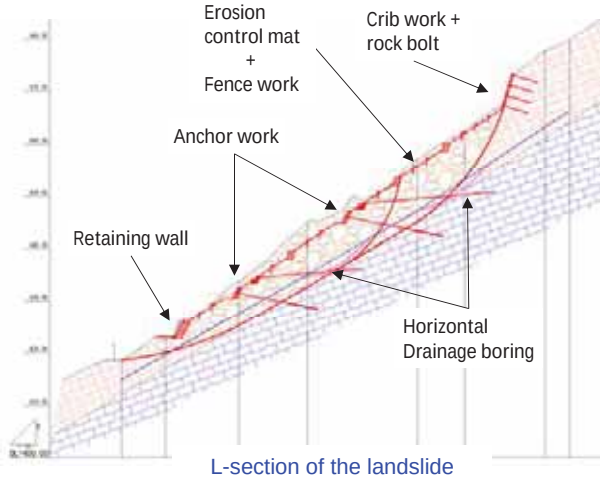
In addition, it is important to carry out to monitor after construction of the countermeasure work whether the effect of the countermeasure work is obtained.

2.3 Plan case of countermeasure works

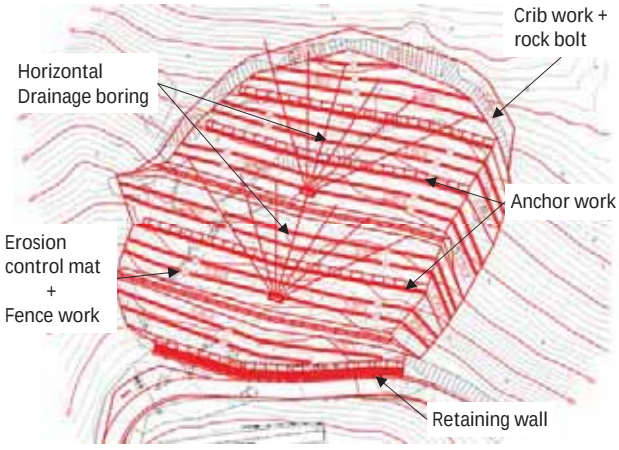
When disaster occurs



After construction work



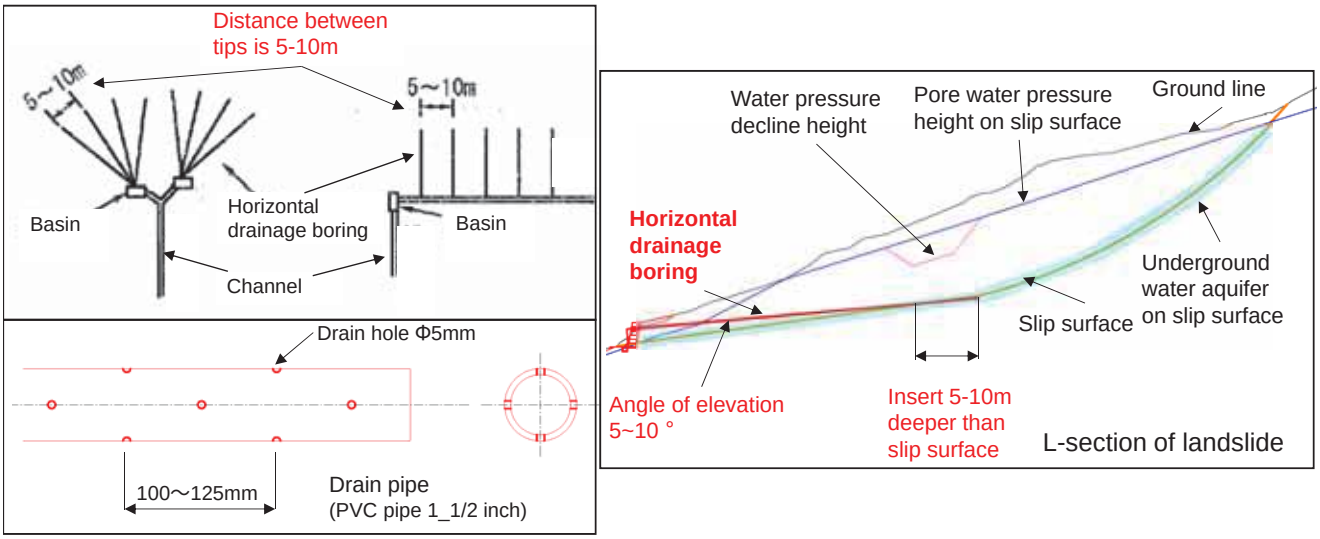
L-section of the landslide



Plan view of the landslide

3. Designing of horizontal drainage boring

3.1 Structural and arrangement of Horizontal drainage boring



Horizontal drainage boring is intended to drain groundwater in the groundwater aquifer on the slip surface.

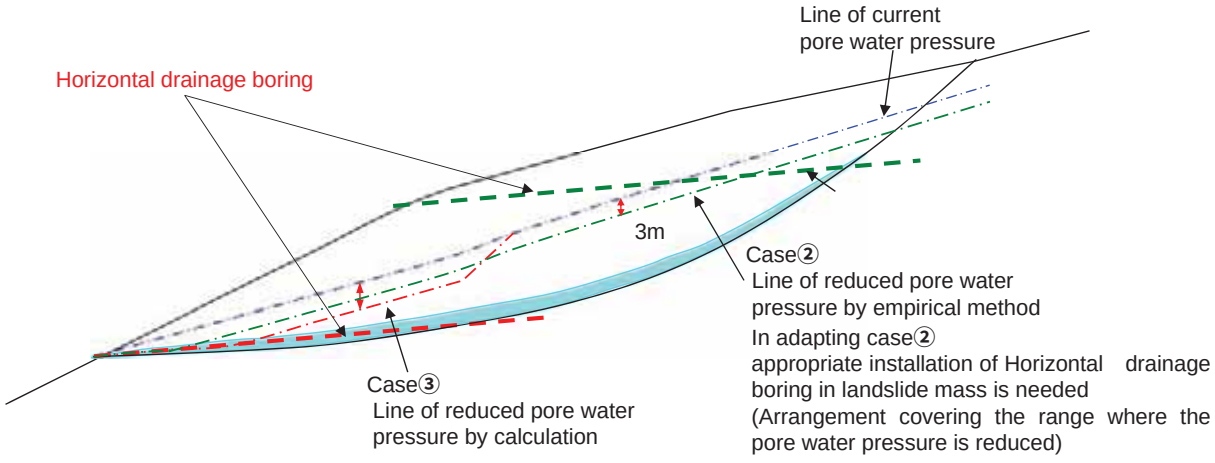
This is a method of drilling diagonally upward from the surface to the slip surface and inserting a drain pipe through the slip surface.

And this method id drilled at an angle of elevation of 5-10 ° , to 5-10 m deep from the slip surface, and insert a drainage pipe.

The horizontal drainage boring are generally arranged in rows or fans, and the intervals are about 5-10 m(as shown in the above figure).

The drain pipe to be inserted is generally a 1-1/2 inch PVC pipe, and the water collection holes are arranged (as shown in the above figure).

3.2 Estimation of the decline in groundwater level and calculation of safety factor of landslide



When estimating the effect of horizontal drainage boring, the reduction in pore water pressure is assumed, stability calculation is performed based on the result, and the safety factor is evaluated.

How to assume reduction in pore water pressure is shown as follow.

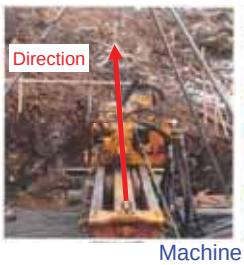
Case① Estimation by near site experience or geological characteristics.
Case② If it is difficult to estimate, empirically plan a reduction of about 3 m.
(Even if the calculated safety factor increases by 5% or more, the effect is limited to 5%)
Case③ Height and range of reduced pore water pressure is decided by Calculation.

In any case, it is necessary to carry out monitoring after the construction work to confirm the effect.

3.3 Construction method

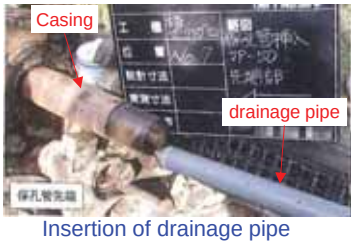
<Construction flow>

- Machine setting
- Drilling
- Cleaning in the hole
- Rod extubation (Inner rod)
- Insertion of drainage pipe
- Casing extubation (outer tube)
- Machine relocation



Machine setting

Drilling

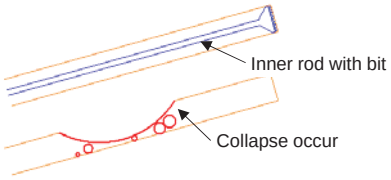


Insertion of drainage pipe

Casing extubation

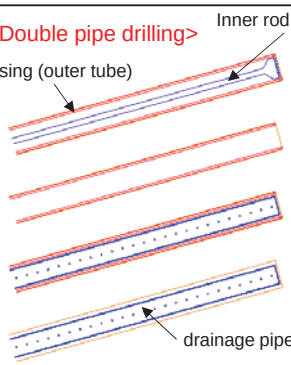
Complete

<Single pipe drilling>



・The hole wall collapses and the drainage pipe tube cannot be inserted.
・Cementation cannot be adopted, because it impairs the water collection effect.

<Double pipe drilling>



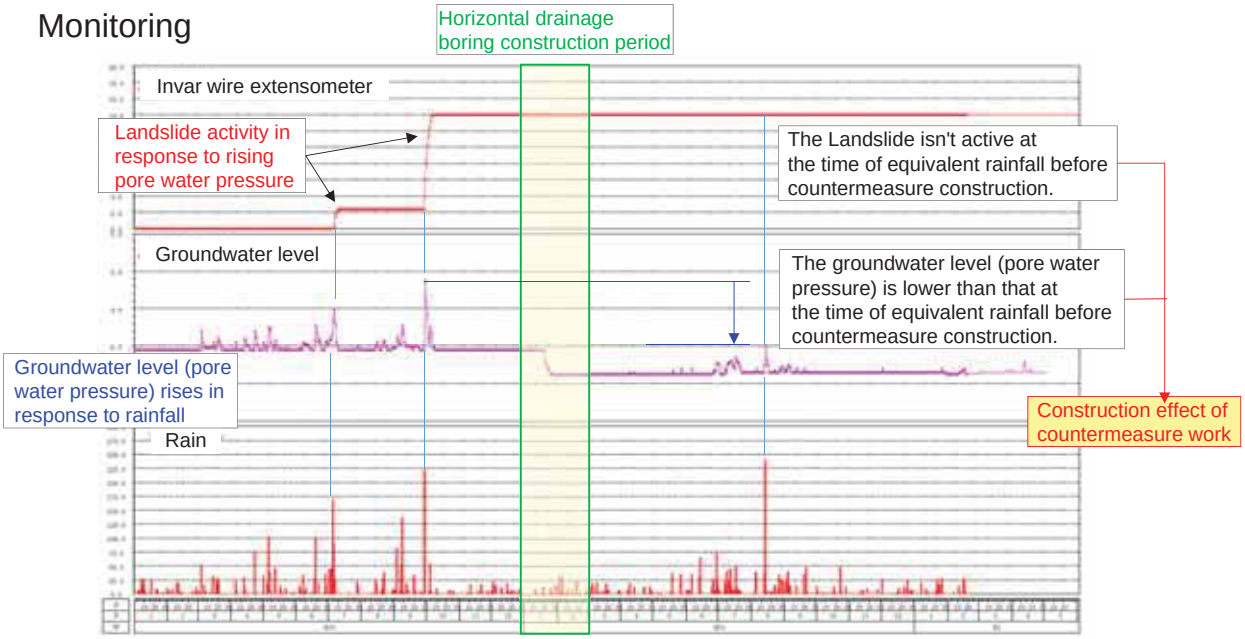
Protect the hole wall with outer tube

Insert the drainage pipe

Casing extubation

Since the landslide mass is loose and weak, it is necessary to take measures to prevent collapse of the hole wall during drilling.
In principle, double pipe excavation is performed when drilling.

3.4 Monitoring



The above figure shows an example of monitoring to confirm the construction effect of countermeasure work.
Before construction of the countermeasure work (horizontal drainage boring), groundwater level (pore water pressure) rises in response to rainfall, and landslides are also active.
After the construction work, the rise of groundwater level is suppressed and the landslide activity is stopped at the time of equivalent rainfall before construction.
It is judged to be the construction effect of the countermeasure work.

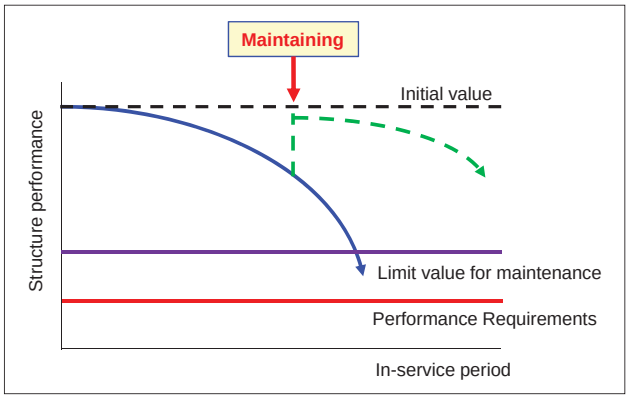
The safety factor is calculated by reflecting this monitoring result (groundwater level) in the stable calculation.
This result is quantitatively shown as the construction effect of the countermeasure work.

At the same time, it is important to confirm whether there is any deformation on site and the status of countermeasure work (deformation, etc.) while observing the measuring equipment.

3.5 Maintenance

Clogging of drain pipe due to slime

Cleaning of holes with high-pressure water



Implementation of maintenance by
"Preventive maintenance management method".
This method is aimed to prevent remarkable deterioration of required performance by frequent inspection and small measure works.

<Flow of functional deterioration>

Clogging of drain pipe due to slime → Poor water drainage capacity → Decrease in drainage effect of groundwater acting on landslide → Landslide instability → Landslide activity → Horizontal drainage boring damage

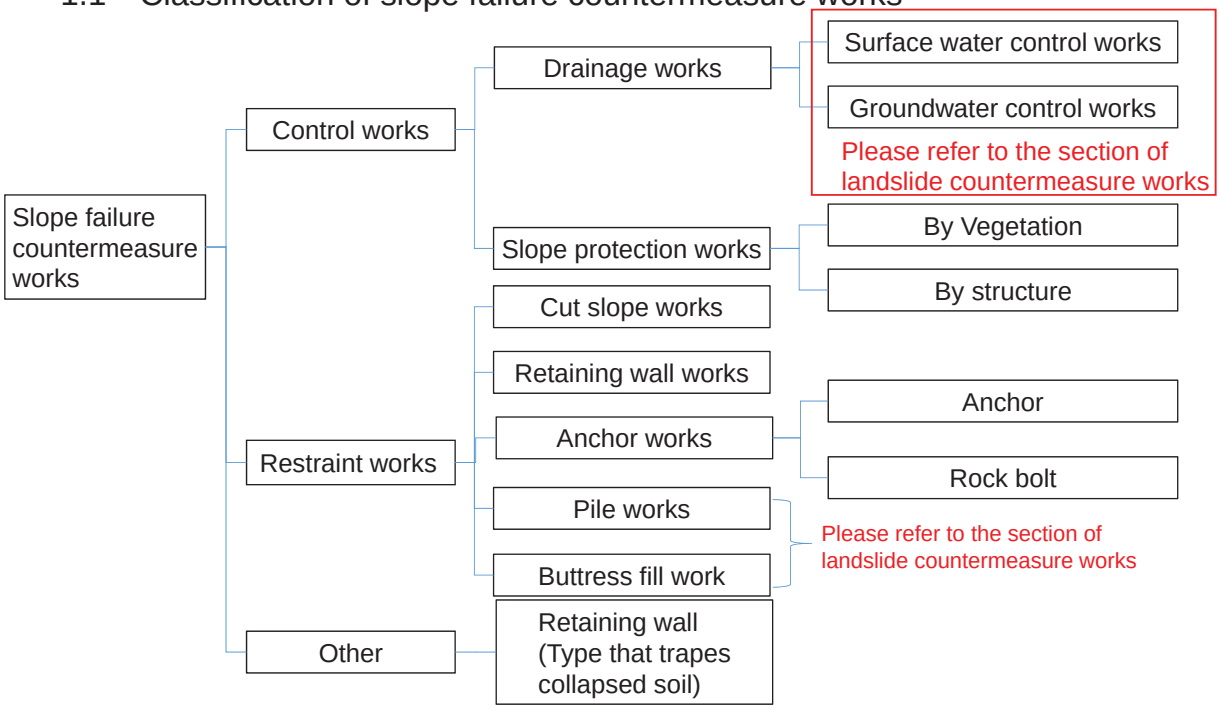
It is important to prevent functional deterioration and to extend the life of the facility by frequent inspections and repairs (cleaning inside holes).

Slope failure & Rockfall

＜Table of contents＞

1 Introduction of slope failure countermeasure works

1.1 Classification of slope failure countermeasure works



Slope failure countermeasure works are divided into Control works and Restraint works.

Control work : Countermeasures to prevent the effects (erosion, etc.) of rainwater, etc.

Restraint work : Countermeasures to change slope balance by structure so that collapse does not occur even if it is affected by rainwater etc.

1.2 Control work : Slope protection works <Revegetation work>

Vegetation mat work

This is method that the net with seeds, fertilizer and fertilizer bag is spread on the slope and fixed with anchor pins or pegs.

Vegetation base material spraying work

This is method that is to spray by mortar gun organic base material (with seeds and fertilizer) to a thickness of 3 to 10 cm according to the greening target and slope conditions. Before spraying the slope is attached metal net for fixing sprayed material.

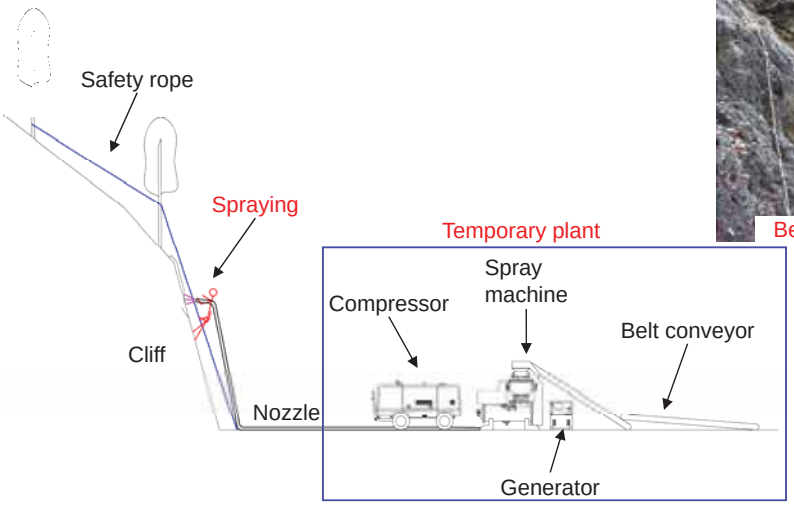
After revegetation work

Slope revegetation is construction methods that protect the surface of slope by growing plants on the slope.

By covering the slope with a plant, it is possible to prevent erosion of the slope by rainwater and suppress weathering.

On the other hand, slope revegetation does not have the mechanical function like structures, so it is necessary to use slope protection work with structures on slopes that may collapse.

1.2 Control work : Slope protection works <Shotcrete work>



Shotcrete work concept diagram

Exterior

Spraying situation

Shotcrete work is a method of spraying concrete(mortar) on natural slopes (cliffs) and slopes that are prone to weathering and erosion, and is constructed to protect slopes from weathering and erosion and to prevent small collapse and rock fall.
Shotcrete work is a method of spraying concrete(mortar) with a thickness of 3-10 cm onto a cliff or slope, and generally has no deterrent, and It is a premise that the slope is self-sustaining and stable.

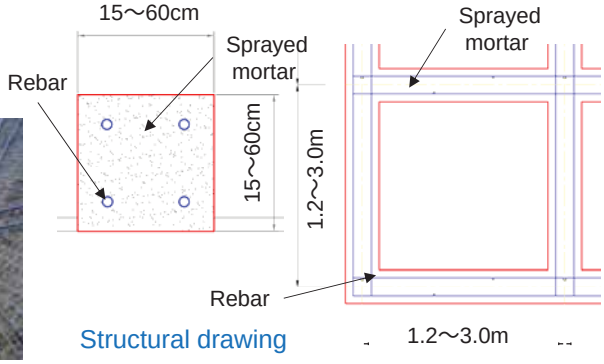
1.2 Control work : Slope protection works <Crib work>

Wire mesh installation

Bar arrangement

Form work

Spraying



Structural drawing

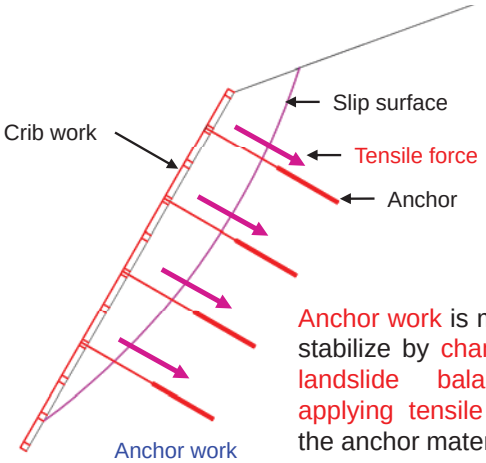
Exterior

Crib work is a construction method that stabilizes the slope by creating grid-shaped reinforced mortar(concrete) on the slope.
It is used to prevent collapse of the surface layer and as a reaction force structure for anchor and rock bolt.

It is common to build a structure by spraying mortar (concrete)

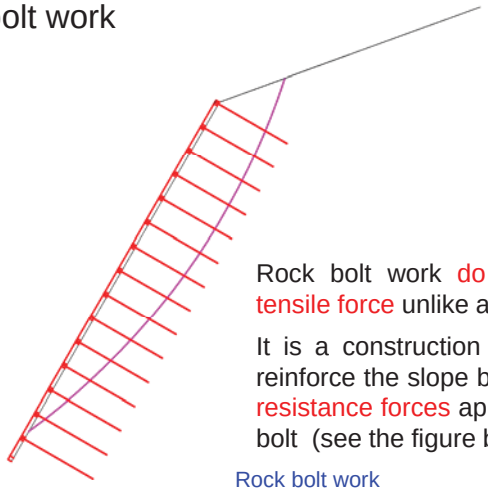
It is generally that beam size is generally 15 cm to 60 cm, and grid size is generally 1.2 m to 3.0 m.
The size is set according to the target collapse scale and the design strength of the anchors and rock bolts.

1.3 Restraint work : Anchor work & Rock bolt work



Anchor work

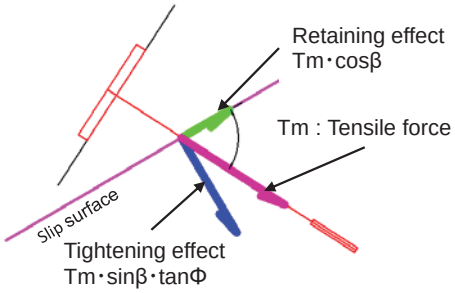
Anchor work is method to stabilize by changing the landslide balance by applying tensile force to the anchor material.



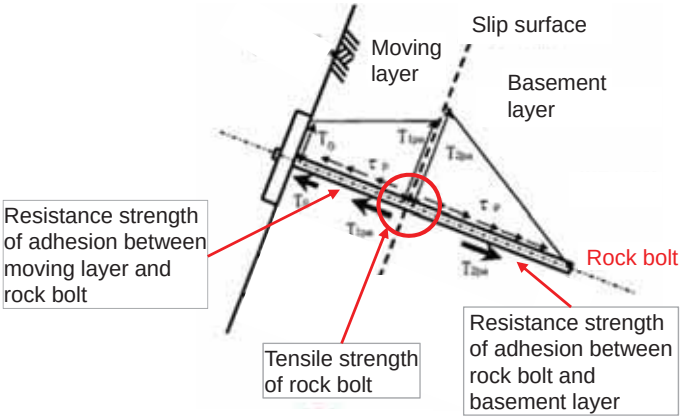
Rock bolt work

Rock bolt work do not apply tensile force unlike anchors.

It is a construction method to reinforce the slope by the three resistance forces applied to the bolt (see the figure below).

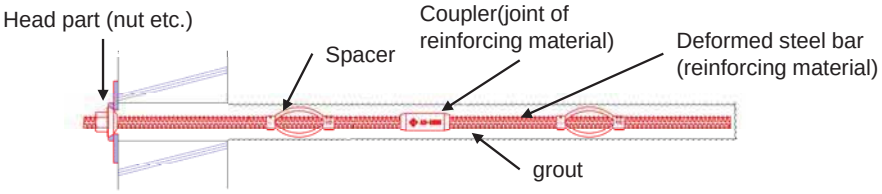


Function of Anchor



Function of Rock bolt

<Rock bolt work>



Rock bolt structure diagram

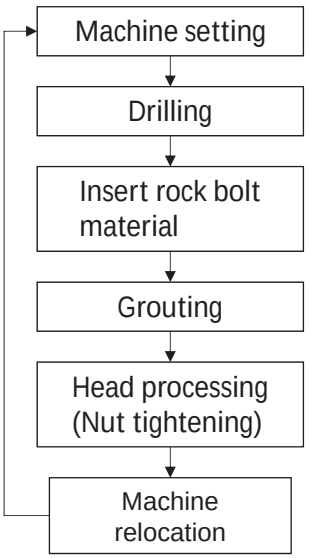
Rock bolt material

Crane hanging drilling method

Drilling by boring machine

Drilling scene in Honduras

<Construction flow>

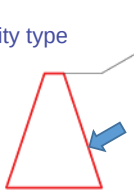


"See the landslide section for anchor work"

1.4 Restraint work : Retaining wall

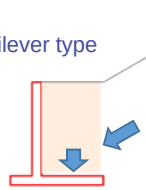
Classification by stability mechanism

Gravity type



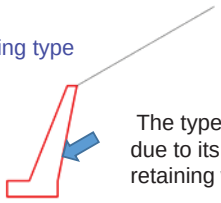
A type that resists earth pressure due to the gravity of the retaining wall
Concrete structure is common

Cantilever type



A type that resists earth pressure due to the gravity of the soil upper the retaining wall and the member strength of the cantilever.
Reinforced concrete structure is common

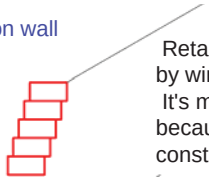
Leaning type



The type that resists earth pressure due to its own weight by leaning the retaining wall against a slope

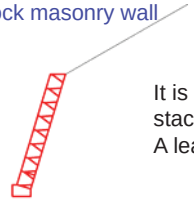
Classification by material

Gabion wall



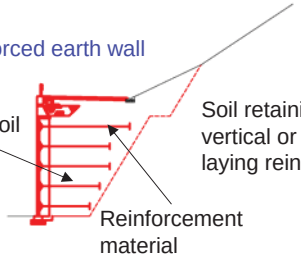
Retaining wall made of a basket braided by wire and filled with stones.
It's made in various parts of the world because of its simple structure ,easy to construct and easy to obtain material.

Concrete block masonry wall



It is a retaining wall type made by stacking concrete blocks.
A leaning type retaining wall is common.

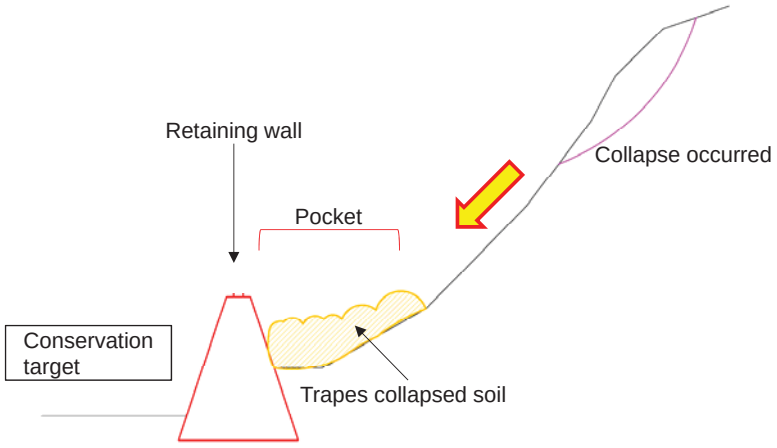
Reinforced earth wall



Soil retaining structure that constructs a vertical or near-vertical wall surface by laying reinforcements in the embankment.

The retaining wall is an earth retaining structure that is continuously provided in the shape of a wall for the purpose of stabilizing the slope.
Retaining walls are classified according to the main material, shape, mechanical stability mechanism, etc.
As a measure against collapse, the size of the slope that can be supported by the retaining wall is limited, and it is often used to fix the slope toe.

Retaining wall
(Type that trapes collapsed soil)



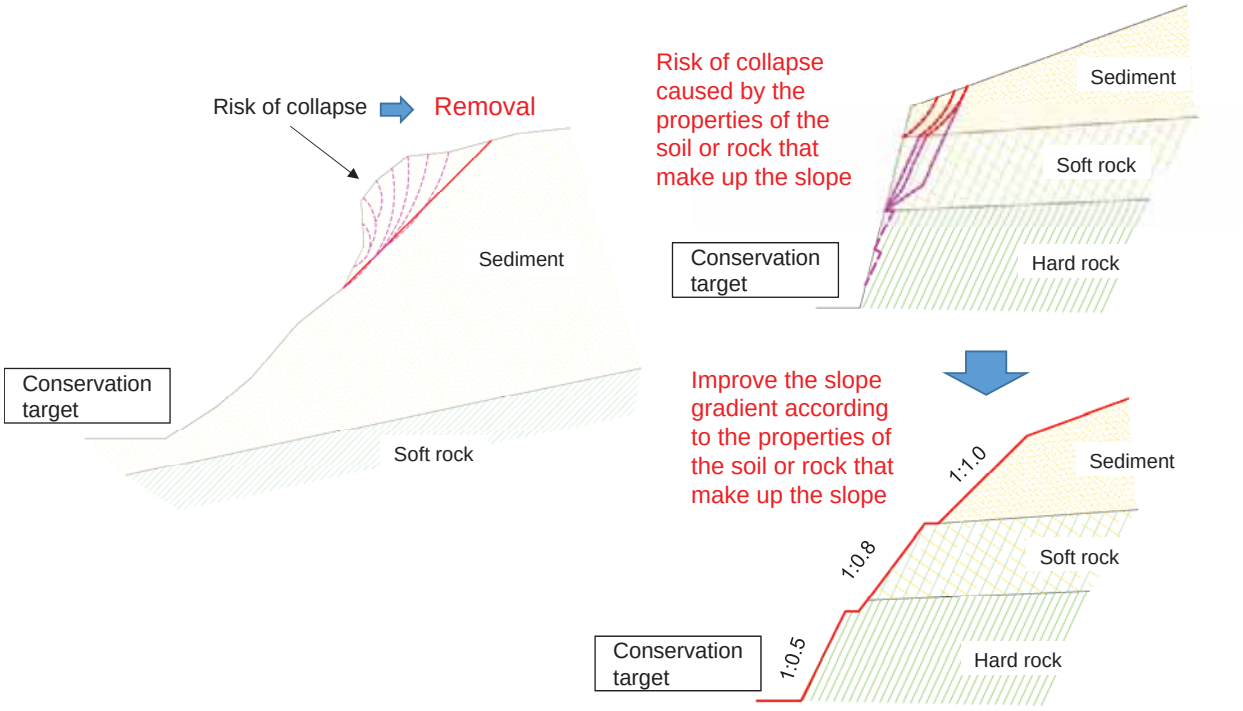
Exterior

If it is not possible to directly control the collapse of the slope, there are cases that retaining wall (type that trapes collapsed soil) planned.
This type generally has a space on the back of the retaining wall to receive the collapsed soil.
Also, the rockfall protection wall that catches rock falls has the same shape.

1.5 Restraint work : Cut slope work

The purpose of cut slope works in collapse prevention is as follows.

- Removing unstable parts.
- Improve the slope gradient according to the properties of the soil or rock that make up the slope.



Standard Gradients of Cut Slope(Japan standard)

Soil classification		Cut Slope Height	Gradient Vertical : Horizontal
Hard rock			1:0.3 to 1:0.8
Soft rock			1:0.5 to 1:1.2
Sand	Not dense, and poorly graded		1:1.5 to
Sandy soil	Dense	Less than 5m	1:0.8 to 1:1.0
		5 to 10m	1:1.0 to 1:1.2
	Not dense	Less than 5m	1:1.0 to 1:1.2
		5 to 10m	1:1.2 to 1:1.5
Sandy soil mixed with gravel or rock masses	Dense, or well graded	Less than 10m	1:0.8 to 1:1.0
		10 to 15m	1:1.0 to 1:1.2
	Not dense, or poorly grade	Less than 10m	1:1.0 to 1:1.2
		10 to 15m	1:1.2 to 1:1.5
Clayey soil		0 to 15m	1:0.8 to 1:1.2
Clayey soil mixed with rock masses or cobble-stone		Less than 5m	1:1.0 to 1:1.2
		5 to 10m	1:1.2 to 1:1.5

It is necessary to take into consideration as follow situation
the geology and soil properties that compose the slope,
groundwater conditions,
the surrounding slope properties,
And then it is necessary to adopt a gradient suitable for each slope.

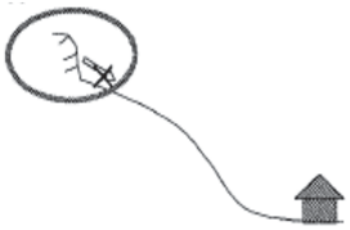
It is important to care to the destabilization of the surrounding slope due to cut slope work.
It is necesarry to prevent erosion by slope protection work at cut slope.

2 Introduction of rockfall countermeasure works

2.1 Classification of rockfall countermeasure works

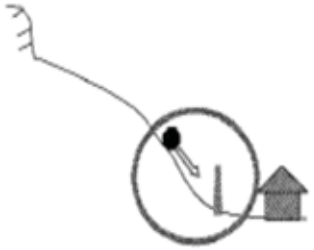
- Rockfall prevention work

This work represents **countermeasures taken against t source of rockfall** to remove or fix rocks that may f These countermeasures are reliable, but **if there are ma sources of rockfall, it is difficult to take su countermeasures completely.**



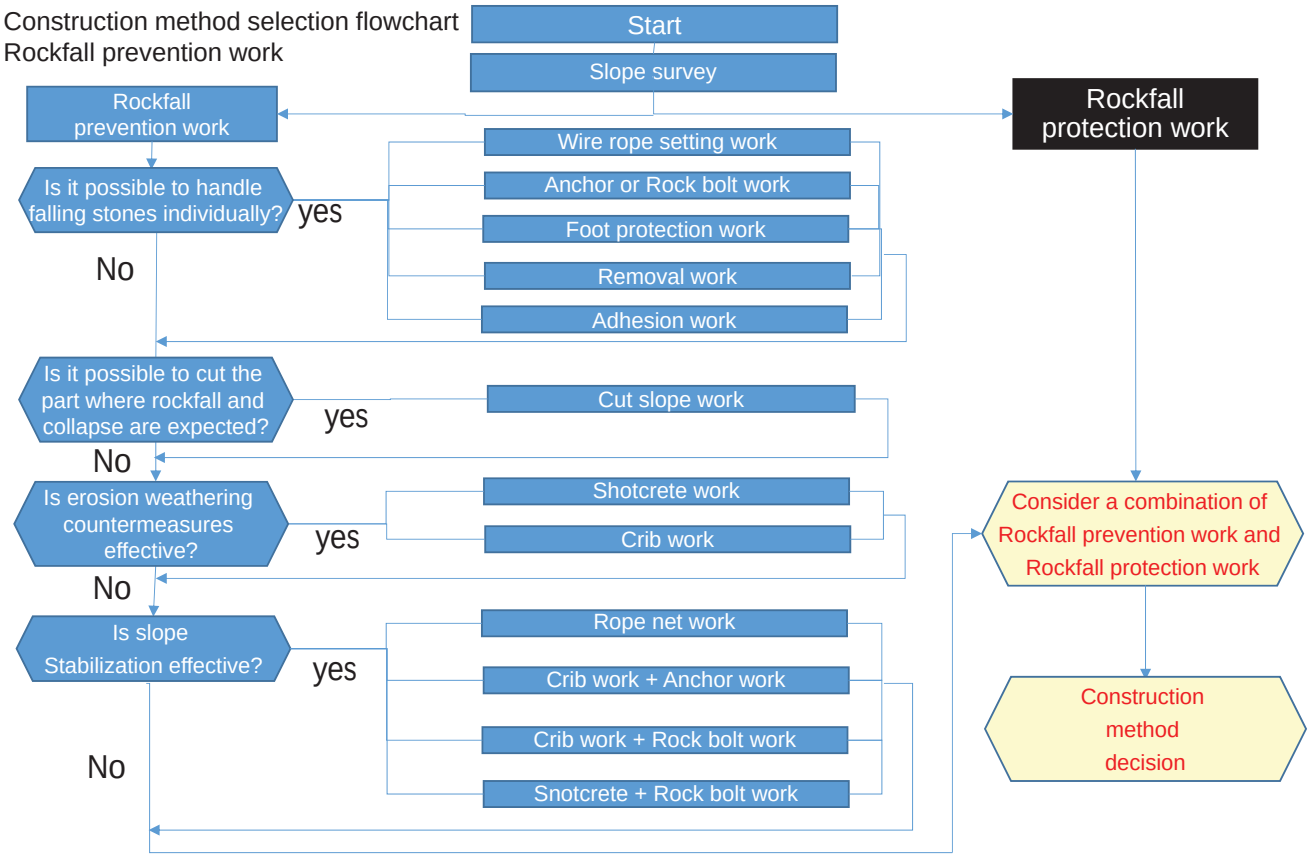
- Rockfall protection work

This work is performed to capture falling stones and reduce their energy on the side or lower part of the mountain **between the source of rockfall and the object to be protected** If the work is installed near the conservation target to be protected, the size of the countermeasure will be larger since energy of a falling stone becomes larger.



.

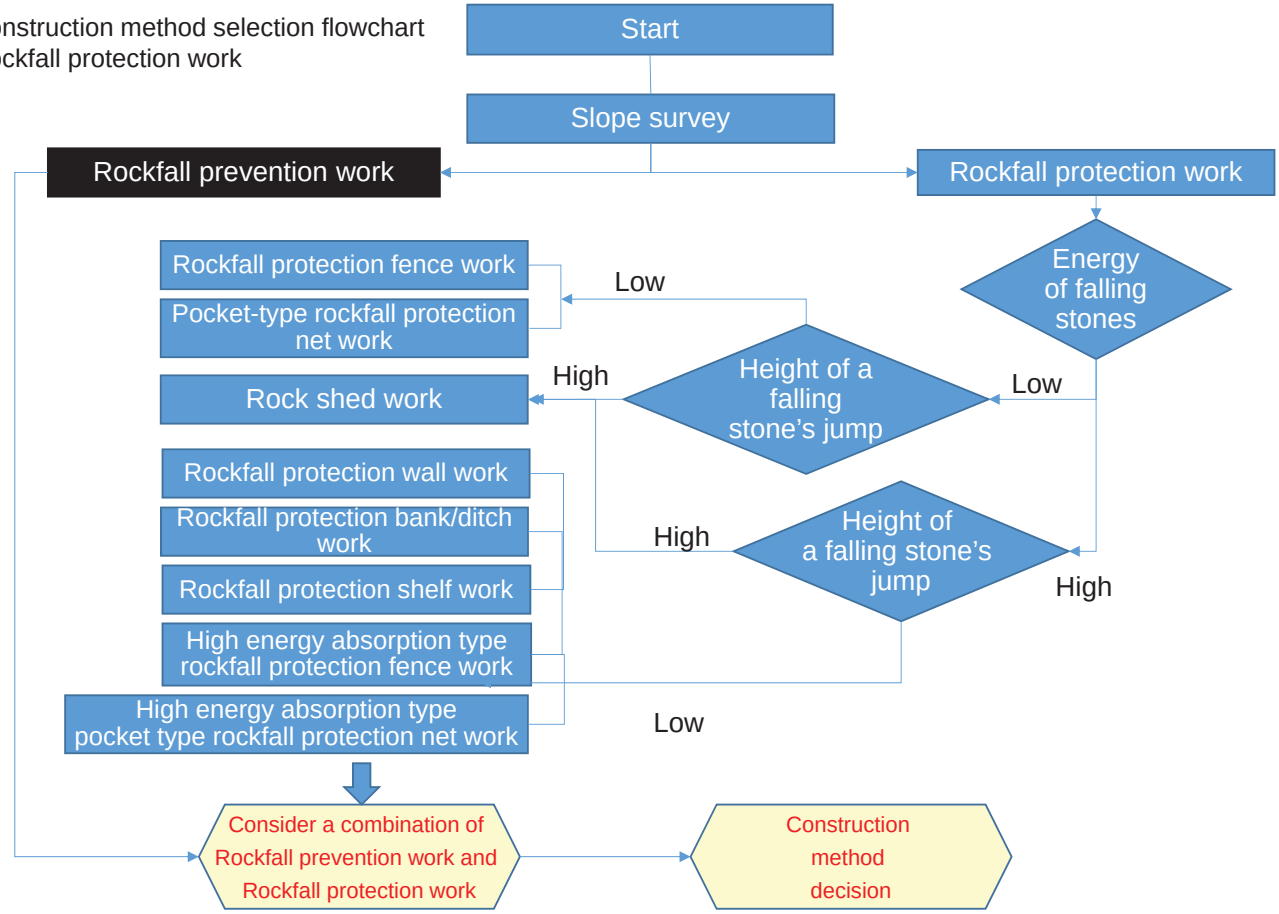
Construction method selection flowchart
Rockfall prevention work

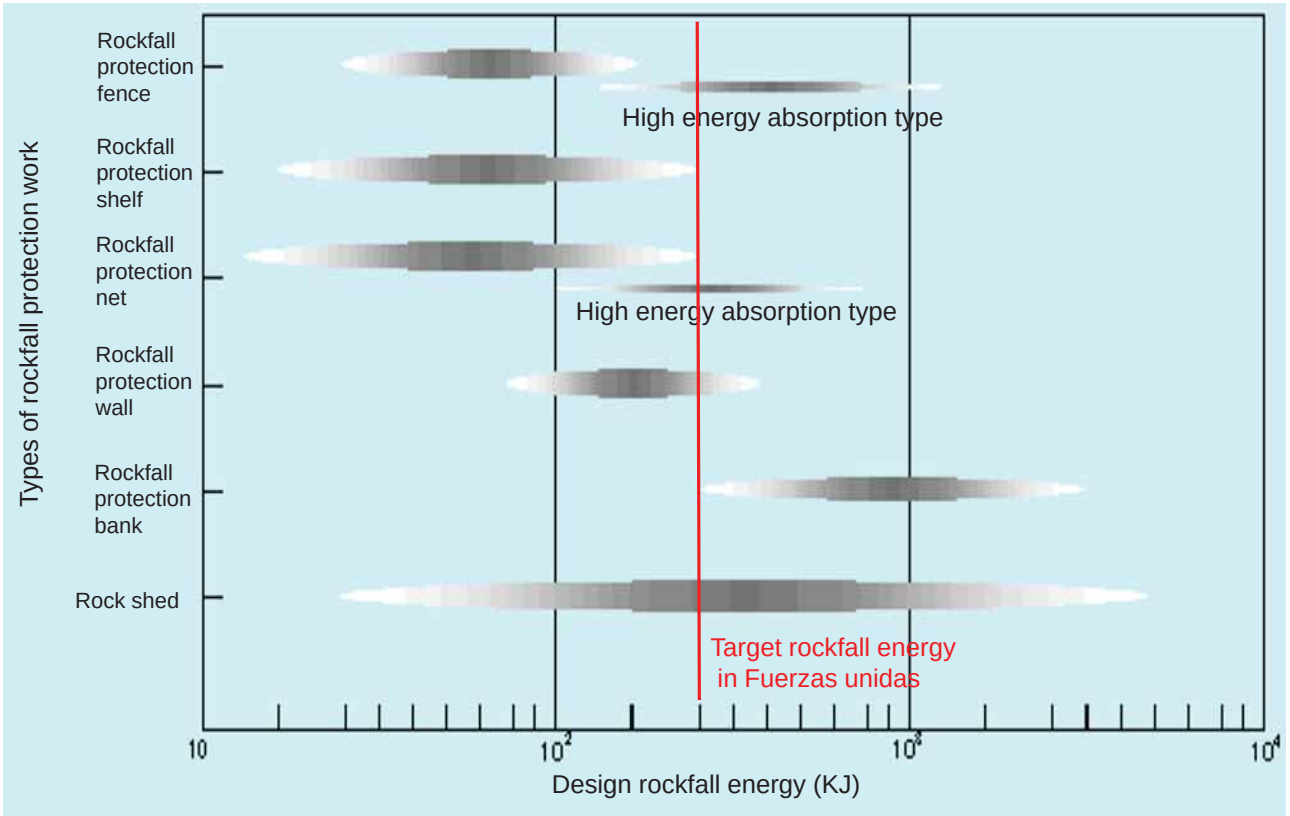


It is important to measure the type, scale, properties, and stability of the entire slope (whether it is rockfall caused by rock mass collapse or sediment collapse).

It is desirable to plan countermeasures in combination with rockfall protection works effectively.

Construction method selection flowchart
Rockfall protection work



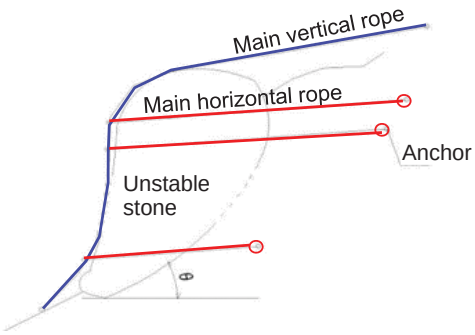


Available rockfall energy for each type of rockfall protection work (approximate)

2.2 Rockfall prevention work Rope net setting work & Foot protection work

<Rope net setting work>

Rope net setting work

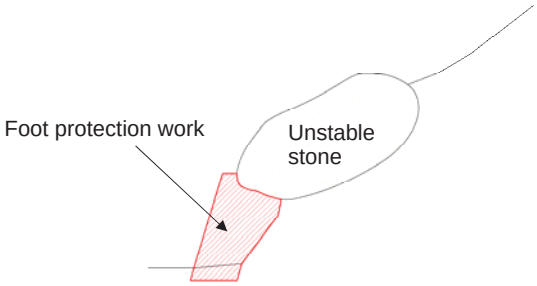


Rope setting work is method that directly covers loosen rock by grid-like net of wire ropes or several wire ropes and edge of wire is fixed to immovable ground.

This method is used when unstable stones cannot be removed from the site and it is necessary to fix them in place.

<Foot protection work>

Foot protection work

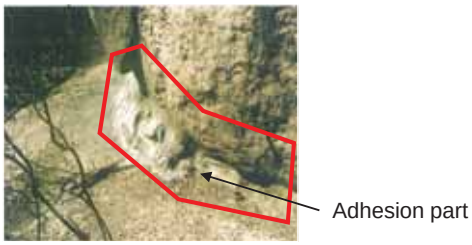


Foot protection work is a method of solidifying the base and surroundings of unstable stones with concrete etc.

2.3 Rockfall prevention work Adhesion work & Cut slope work

<Adhesion work >

Adhesion work



Rock adhesion work is a method of preventing rockfall by using an adhesive to increase the adhesion between the stone and the ground which they touch.

It is got the effects by filling, closing, or adhering cracks using adhesive agents.

Since injecting an adhesive into the voids such as cracks, it is possible to suppress instability by preventing infiltration of rainwater and reducing vibration due to earthquakes and winds.

<Cut slope work>

Before construction

After construction

Excavation with hanging excavator

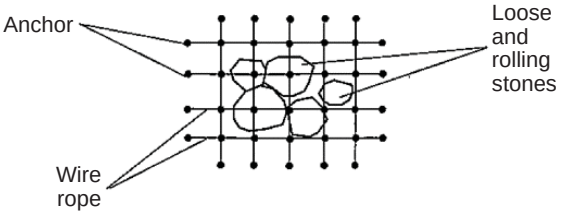
This case is that Huge unstable rock masses are distributed over the slope and it is difficult to fix them in-situ and to prevent rock fall by rock fall protective works.

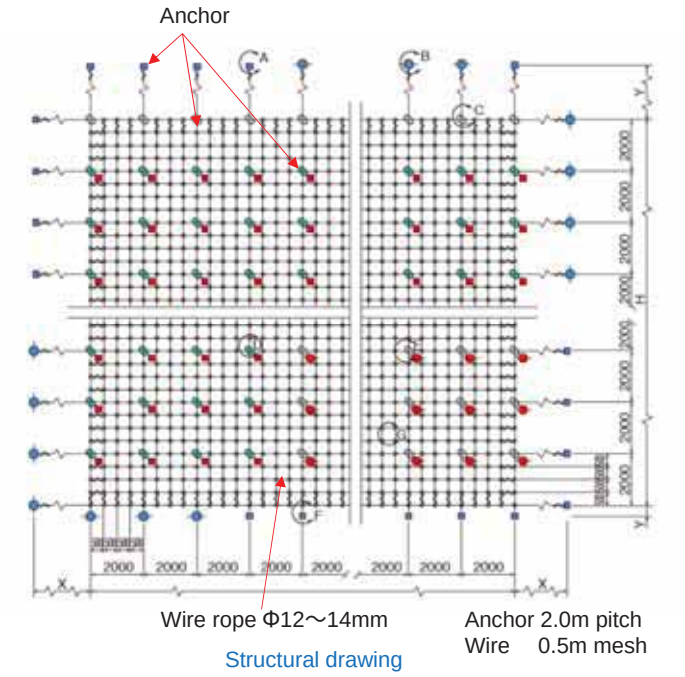
It is adopted method that is removed unstable rock mass by cutting slope.

It is desirable to prevent weathering erosion by slope protection works on slopes after cutting

2.4 Rockfall prevention work　Rope net work

Exterior





Structural drawing

Rope net work is a method that covers loose and rolling stones with a grid-like net of wire ropes and drives anchors at the point where wire ropes meet so that the net is fixed to the slope.

Since this method covers the slope widely, it is often used for groups of loose or rolling stones.

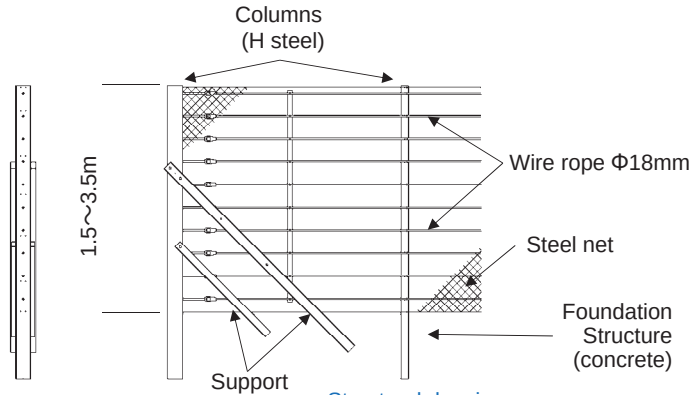
It is a method to hold down rocks by tension strength of wire mesh and pulling strength of anchor.

2.5 Rockfall protection work　Rockfall protection fence work

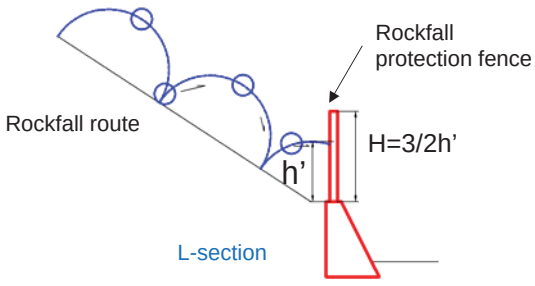
Exterior (Front)

Exterior

Exterior(Back)



Structural drawing



L-section

It is a method to prevent rockfall by absorbing rockfall energy by the tension of the wire mesh and wire rope.

Generally, this method is suitable for small rockfalls of 100kj or less.

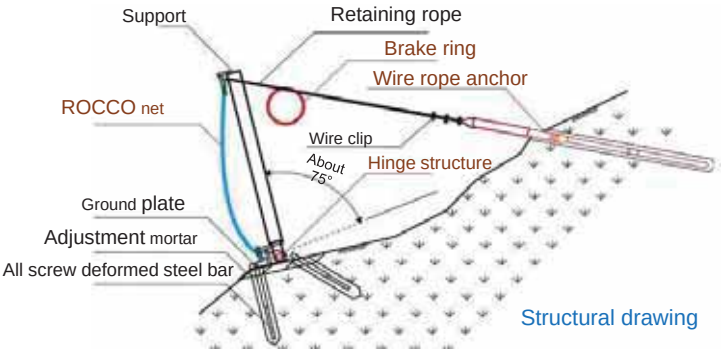
It is assumed that the wire and wire mesh will be deformed and damaged by falling rocks, and it is necessary to replace the members by maintenance.

Maintenance cost　rope & wire : 500$/m　column : 1000$/pc (Approximate cost for 3.0m height specification)

2.6 Rockfall protection work

High energy absorption type rockfall protection fence work

Exterior



Structural drawing

Before energy absorption

After energy absorption

Rockfall catchment situation

High energy absorption fence work is flexibly structured rockfall protection fences consisted of supports, wire ropes, nets, and reaction bodies.

It is a construction method that can absorb high energy by the deformation of the net and the braking system of the wire rope.

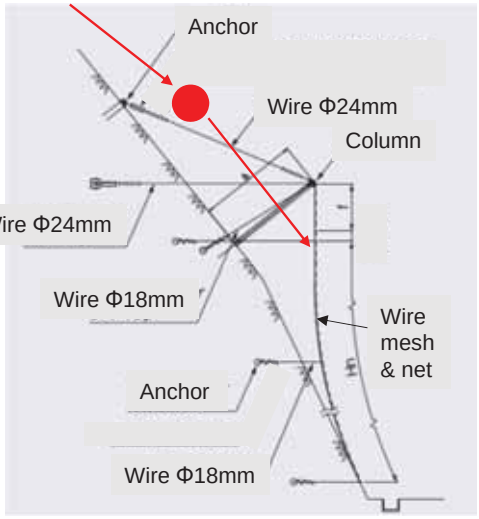
This method is available for Large energy rockfall of 2000kj.

In this construction method as well, member deformation occurs when capturing rockfall, so it is necessary to replace members by maintenance. (Maintenance cost : 8,000$/m)

2.7 Rockfall protection work

High energy absorption type pocket type rockfall protection net work

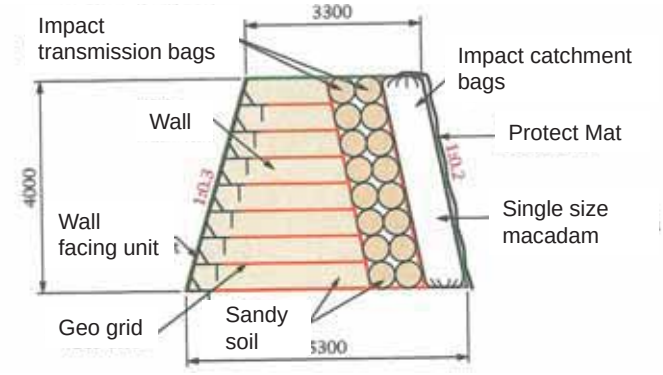
Exterior



Structural drawing

It is rockfall protection net work that absorbs large rockfall energy in composed of wire rope and wire mesh.
Possible absorption energy is ~1000kJ.
It is avalable as a countermeasure for roads where there is not enough space on the roadside.
Since the upper part of the net is open, it can respond to and capture rockfall from high places.

2.8 Rockfall protection work Rock fall protection wall (earth structure)



Structural drawing

Exterior

Highly effective in absorbing energy through deformation because the wall consists mainly of earth.

A large construction yard and a space for waiting for and receiving falling stones are required.

It is available for larger energy rockfall than rockfall protection fences.

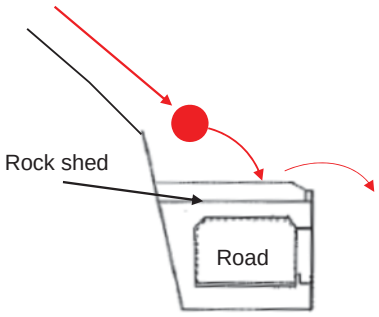
Construction cost is less expensive than High energy absorption type rockfall protection fence work.

Easy to maintain and less expensive than other rockfall protection works.

2.9 Rockfall protection work Rock shed & Rockfall protection shelf work

<Rock shed >

Exterior

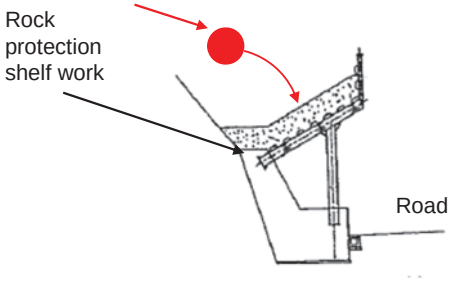


Outline drawing

It is a construction method to construct a shed that covers roads made of reinforced concrete, precast concrete, and steel in order to trap rockfall or drop to the valley side.

<Rockfall protection shelf work >

Exterior



Outline drawing

It is a method of installing concrete or steel shelves along the road to catch and prevent rockfall.

Agencia de Cooperación International del Japón

Honduras
Proyecto para el Control y Mitigación de Desastres en Laderas del Distrito Central

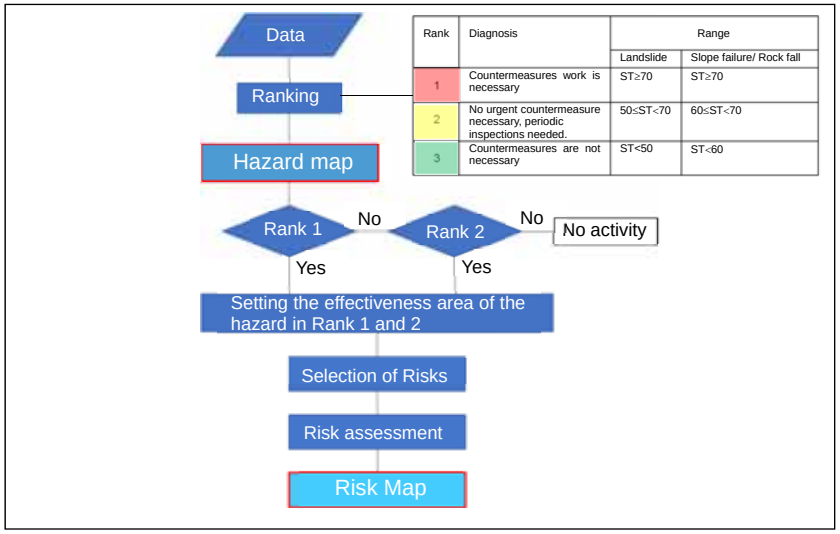
[Materiales de aprendizaje en casa]

Resultado 3: Se fortalece la Capacidad de desarrollar mapas de amenazas y riesgos.

Junio, 2020

Contents:

1. Evaluation of slope stability, 1.1 Procedure of slope evaluation



Rank	Diagnosis	Range	
		Landslide	Slope failure/ Rock fall
1	Countermeasures work is necessary	ST≥70	ST≥70
2	No urgent countermeasure necessary, periodic inspections needed.	50≤ST<70	60≤ST<70
3	Countermeasures are not necessary	ST<50	ST<60

Figure 1.1. Hazard map/risk map creation flow.

Explanation

- Figure1.1 shows the map creation flow from giving the data at field to creating the risk map.
- Data is the result which we got to use check sheet in the field work (Figures 1.5, 1.6, Appendix 1).
- Ranking is made after evaluation data between “Landslide” and “Slope failure/Rock fall”.
- Hazard Map is made according to the ranking that we should be done.
- Rank 1 and Rank 2 in each rhombus correspond with the division of ranking. The Rank 1 shows the highest vulnerable rank coloured red in the table of the Figure 1.1 in three classifications at the slope, whereas the Rank 2 shows middle vulnerable as yellow rank of it.
- The area of the Rank 1 is colored red, whereas the area of the Rank 2 is colored yellow.
- The area for risk corresponds with the Hazard area. Area setting for the risk is referred from the Figure 2.3 (p.15).

Comments

- Creating a risk map by hand helps you to do similar tasks in GIS in the future.

Practice/ Question

- There is no practice in this session.

1.1 Procedure of Slope evaluation (to continue)

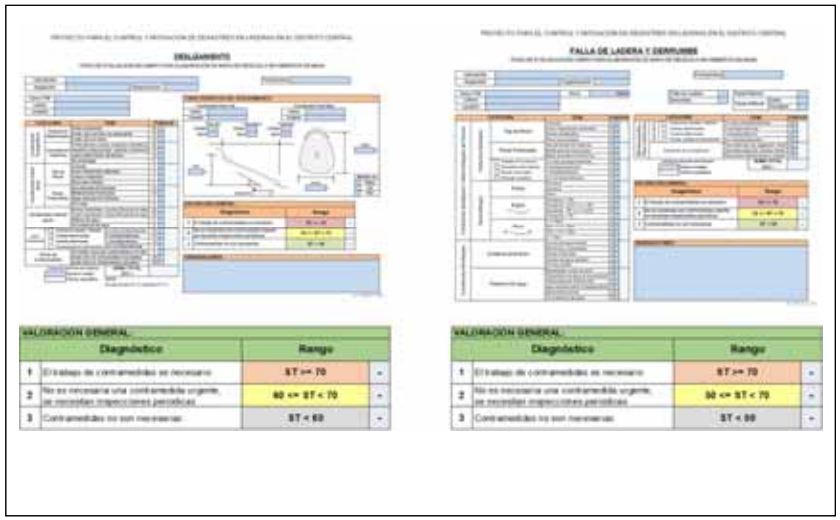


Figure 1.2. Classification of slope evaluation (left: Landslide, right: Slope failure/ Rock fall).

Explanation

- Classification of the Rank 1 to the Rank 3 is the same contents between “Landslide” and “Slope failure/ Rock fall” (Table 1).
- Diagnosis for three ranks are as follows:

Rank 1: Countermeasures work is necessary.

Rank 2: No urgent countermeasure necessary, periodic inspections needed.

Rank 3: Countermeasures are not necessary.

Table 1 Diagnosis for ranking

Rank	Diagnosis	Range	
		Landslide	Slope failure/Rock fall
1	Countermeasures work is necessary.	ST ≥70	ST ≥70
2	No urgent countermeasure necessary, periodic inspections needed.	50 ≤ST <70	60≤ ST <70
3	Countermeasures are not necessary.	ST <50	ST <60

Comments

- Although the areas of classification are different between “Landslide” and “Slope failure/ Rock fall”, this is classified considering the situation of slope stability at the site.

Practice/ Question

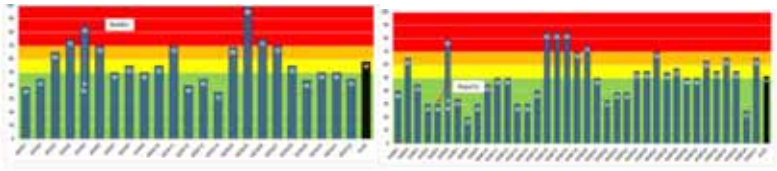
- Let's think about countermeasures for some unstable slopes in Tegucigalpa. If you know a specific example, show it in words, photos, pictures, etc.

Appendix 1: The results for investigation are as the graph of columns.

Landslide

El Edén

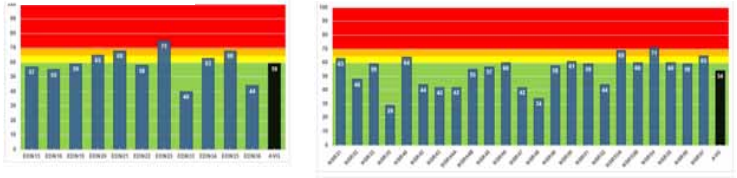
Nueva Santa Rosa



Slope failure/ Rock fall

El Edén

Nueva Santa Rosa



The ranking of “landslide” are as follows: Rank 1: ST≥70, Rank 2: 50≤ST<70, Rank 3: ST<50. From the data of El Edén area as the east part of the pilot area (n=23, average value 57, median 50) and Nueva Santa Rosa area as the west part of it (n=38, average value 50, median 50). The average value is slightly higher in El Edén (57), but the median value is 50, which is the boundary between the Rank 1 and the Rank 2, and is an appropriate limit from the perspective of slope stability.

On the other hand, the ranking of "slope failure/rockfall" is as follows: Rank 1: ST≥70, Rank 2: 60≤ST<70, Rank 3: ST<60. Due to the data of El Edén area (n=11, average 59, median 59) and Nueva Santa Rosa area (n=23, average 59, median 59), both average and median are 59 values. The division between the Rank 1 and the Rank 2 shows an appropriate limit from the perspective of slope stability.

1.2 Definition of vulnerable slopes

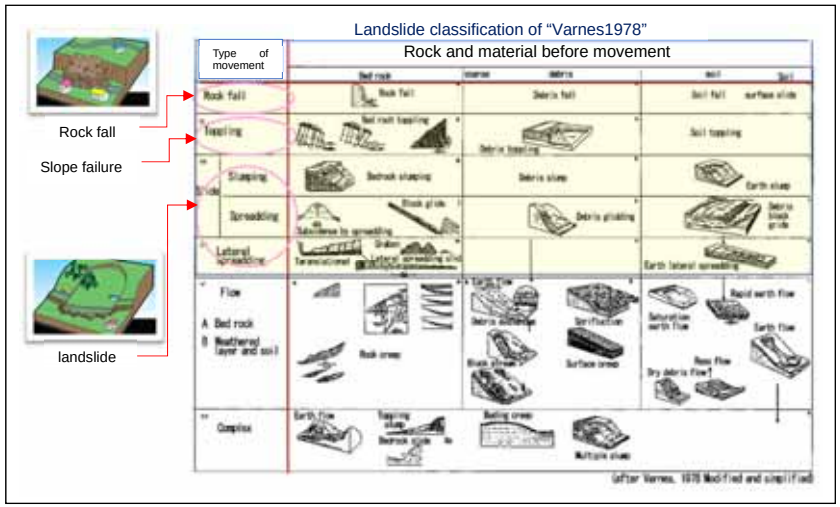


Figure 1.3. Relationship between our classification and classification of Varnes' (1978)

Explanation

- Varnes' classification is based on a combination of "Type of movement" and "Materials" of landslides, and is recognized the classification method scientifically in the world. On the other hand, the slopes which we treat are classified mainly for planning to countermeasures, and the expressions are different but correspond to the Varnes' classification (Figure 1.3).
- This project refers to the classification of "Slope Disaster" in Japan. This classification is a method that is unique to Japan and is based on the phenomenon that basically focuses on countermeasures with a classification method specialized in the field of slope disaster (Appendix 2, p.5).
- It is divided into 3 categories: Debris flow, Slope failure and Landslide.
- In this project, select 2 out of 3 categories of Japan's classification, for example, Slope failure as “Slope failure/ Rock fall” and Landslide as “Landslide”, and define as follows:

◇ Slope failure/ Rock fall:

- Natural phenomenon where land with a slope of 30° or more collapses..
- Collapse of a slope without a slip surface.

◇ Landslide:

- A natural phenomenon in which a part of the land slips due to groundwater, or moves with it.
- A material (rock/soil) that has a slip surface and moves on a slip surface with low angle.

Comments

- "Slope failure/ Rockfall" and "Landslide" used in the project are classification methods with countermeasures in mind.

Practice/ Question

- if any comment and/or question.

Appendix 2: Classification of "Slope Disaster" by Ministry of Land, Infrastructure and Transport Infrastructure Development Institute-Japan.

Debris flow

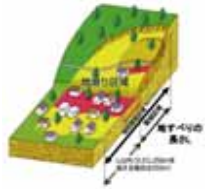
Slope failure/ Rock fall

Landslide

Debris flow	This is a phenomenon in which soil and rock on the hillside or in the riverbed are carried downward at a dash under the influence of a continuous rain or a torrential rain. Although the flow velocity differs by the scale of debris flow, it sometimes reaches 20-40 km-hr, thereby destroying houses and farmland in an instant.
Slope failure	In this phenomenon, a slope abruptly collapses when the soil that has already been weakened by moisture in the ground loses its self-retainability under the influence of a rain or an earthquake. Because of sudden collapse, many people fail to escape from it if it occurs near a residential area, thus leading to a higher rate of fatalities.
Landslide	This is a phenomenon in which part of or all of the soil on a slope moves downward slowly under the influence of groundwater and gravity. Since a large amount of soil mass usually moves, a serious damage can occur. If a slide has been started, it is extremely difficult to stop it.

Debris flow

Slope failure/ Rock fall

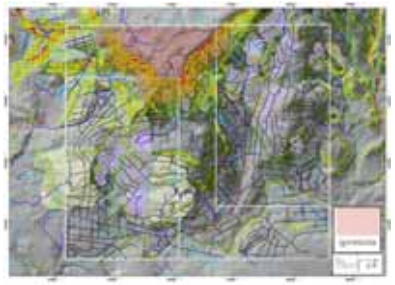


Landslide

The Red zone and Yellow zone of two Slope Disaster as "Slope failure/ Rock fall" and "Landslide" shown at the bottom of Appendix 2 are used as references when creating the risk map. Appendix 7 (p.16) in the session 2.3 explains the definition of the Red zone and Yellow zone.

[Screening for "Landslide" and "Slope failure/ Rock fall" in the 1.2 session]

"Landslide" selection based on the previous project data



"Slope failure/ Rock fall" selection based on the screening method

Figure 1.4. Slope selection ways between "Landslide" and "Slope failure/Rock fall".

Explanation

- When selecting the landslide area in the pilot area, we selected it based on the landslide distribution map created in the previous project (Figure1.4, left).
- When screening for "Slope failures/ Rock fall", we did the following process (Figure 1.4, right):
  1) Selection of area where the slope has 30 degrees more.
  2) Selection of area where the relief energy is 5 meters more initially. Then selected area where the relief energy is 10 meters more, because the range 5 to 10 meters area is almost stable due to the field observation.
  3) Exception of the Ignimbrite (welded tuff) distribution area, because this area forms the Hill Picacho where rock fall causes rare and does not affect to the road.

Comments

- Creating a risk map by hand helps you to do similar tasks in GIS in the future.

Practice/ Question

- What is the geology beneath Ignimbrite?
- What is the nature/characteristic of the geology?

1.3 Field investigation with check sheets

[**Landslide**]

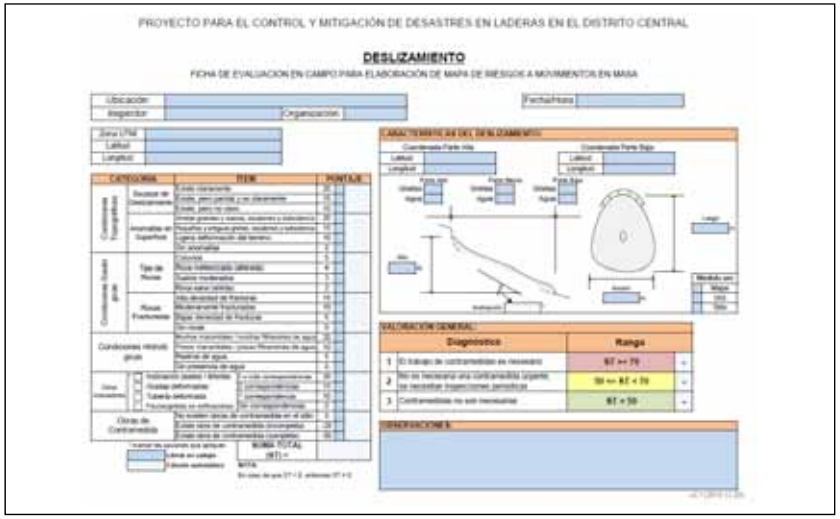


Figure 1.5. Check sheet for “Landslide”.

Explanation

- Basically, based on the characteristics of topography, geology, and hydrology, the survey table was prepared considering the existence of countermeasure works.
- Category as Geology consists of “Rock type” and “Rock fracture”
- Category as Topography consists of “Landslide scarp” and “Surface anomalies”.
- The observation points at the site are shown in Appendix 3, for example.

Comments

The points of investigation in the “Landslide” are as follows:

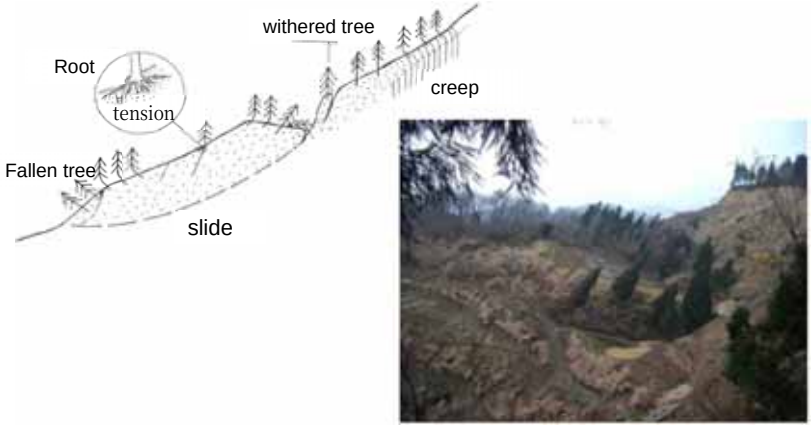
- Be sure to check existing materials and interpret the landslide topography in advance.
- Check the entire view, understand the relationship with roads, and identify signs of landslides such as deformation of structures. Particularly important is whether there are new cracks or depressions.
- Grasp the landslide contour, especially pay attention to the cracks on the head and the deformation such as extrusion and ridges at the end.
- Check surface water and spring conditions. In some cases, reconfirmation is conducted after snowmelt or immediately after rainfall.
- Interviews with local residents are useful.

Practice/ Question

- Let's learn the parts of the landslide (Appendix 4). The schematic diagram of the landslide for training does not put technical terms.

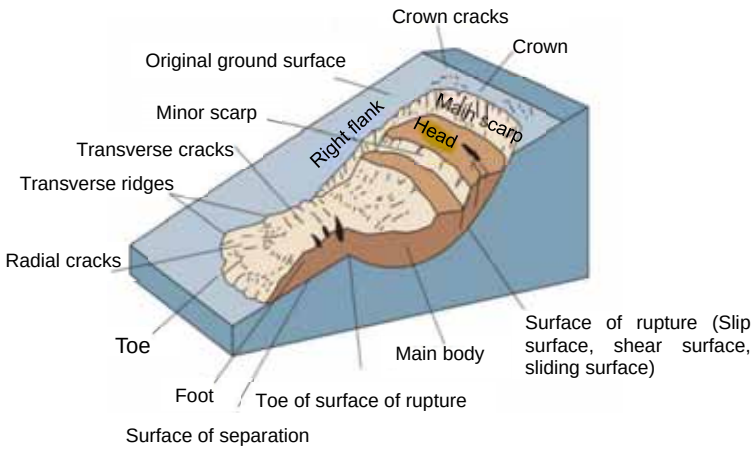
Appendix 3: The observation point

- A case of abnormal vegetation on the slope

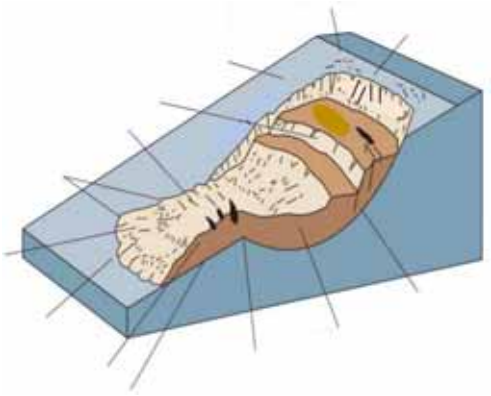


- A case of a crack with step

Appendix 4: The schematic diagram of the landslide (source: USGS).



for Practice



(http://pubs.usgs.gov/fs/2004/3072/)

1.3 Field investigation with check sheets

[**Slope failure/ Rock fall**]

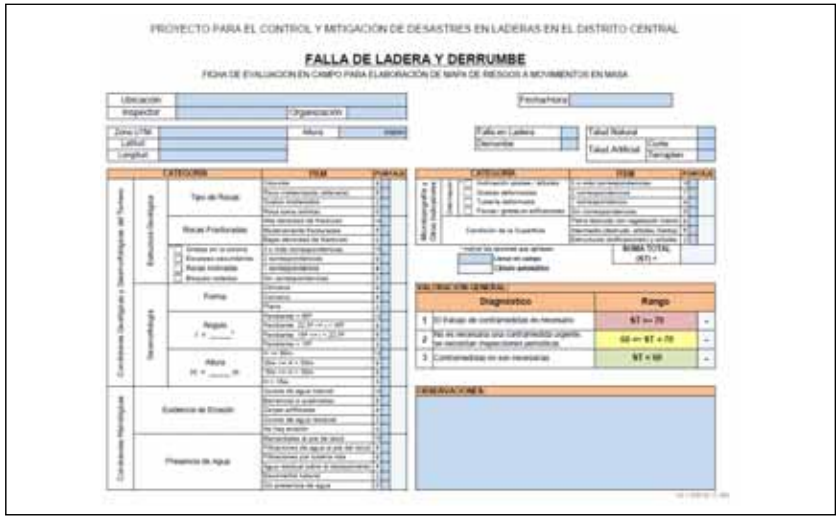


Figure 1.6. Check sheet for “Slope failure/ Rock fall”.

Explanation

- The check sheet was created based on the characteristics of topography, geology, and hydrology, and it was created considering microtopography for topography.
- Topographic category consists of “Form”, “Angle” and “Height”.
- Geologic category consists of “Rock type”, “Rock fractures”, “Cracks”, and “state on slopes”.
- Hydrologic category consists of “Evidence of erosion” and “Presence of Water”.
- The observant points in the field investigation are shown in Appendix 5 and Appendix 6.

Comments

The points of investigation in the “Slope failure/ Rock fall” are as follows:

- In a small concave catchment terrain, surface collapse tends to occur during rainfall, but it is easily overlooked during inspection.
- Seismic motion is amplified on the ridges and slopes, and rockfalls and collapses are likely to occur.
- Be careful of geological structures such as dip slopes that tend to collapse.
- Be careful about topographic changes and tree felling since the last inspection.
- Be careful to the disaster history of adjacent areas.
- Pay particular attention to the following points when inspecting bedrock failure.
- Estimate the scale and collapse form based on disaster history in the same topographical and

geological distribution area, traces of collapse of surrounding slopes and collapse conditions.

- A wide range of areas thought to affect the road (including under the road and steep cliffs on the opposite shore) is used to accurately and efficiently narrow down slopes that may cause rock collapse by using oblique photographs and aerial photographs.
- In the event of a disaster, we carry out inspections that take into account the sections that are considered to take time to restore and the enormous disaster membership fees.
- Since rock mass failure occurs with the progress of destabilization, the development status of discontinuity, the open crack, the overhang status, etc., which reflect the destabilization status, should be accurately grasped.
- Check for latent cracks not only on the front of the cliff but also on the back and sides.。

Practice/ Question

- When observing springs / seepage on slopes, where is the unstable point if water is affected on slopes?

Appendix 5: Nick line (convex) on the slope

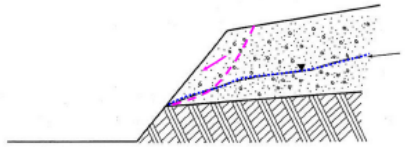
The slope nick line is a particularly unstable place, and examples of the photos are shown below.

Small collapse often occurs near the nick line.

The nick line is said to be the forefront of erosion, and the slopes are often unstable.

On the rock slope, observe the distribution and condition of unstable stones.

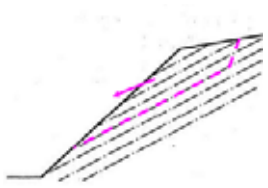
Appendix 6: Geological structure to collapse easily (section view)



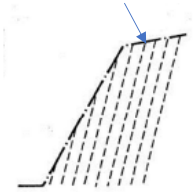
Sediment on impermeable foundation

Bedding plane, schistosity, faults, intrusive surfaces, cracks, etc. form a dip slope

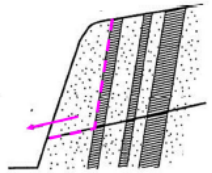
Not the dip slope



Normal Dip slope



A steep Dip slope than a natural slope



Dip slope due to the separated plane

2. Hazard and risk maps in the pilot area,　2.1 Definition between Hazard map and Risk map

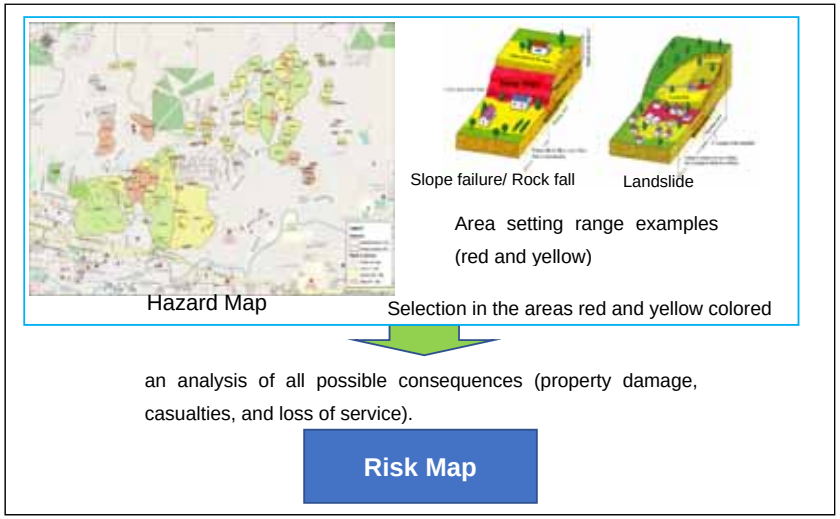


Figure 2.1. Process from creating the Hazard map to the Risk map.

Explanation

- Hazard map is created due to the classification of slope vulnerability after investigation with check sheets in the field.
- Risk map is created risk areas based on the Hazard map, then risk ranking is defined after analyzing of all possible consequences (property damage, casualties, and loss of service).
- According to the web-information of “What is landslide hazard map? (USGS)", definition between Hazard map and Risk map is as follows:

Landslide hazard maps indicate the possibility of landslides occurring throughout a given area. An ideal landslide hazard map shows not only the chances that a landslide might form at a particular place, but also the chance that it might travel downslope a given distance.

Landslide risk maps show landslide potential along with the expected losses to life and property, should a landslide occur. Risk maps combine the probability information from a landslide hazard map with an analysis of all possible consequences (property damage, casualties, and loss of service).

Comments

- In the future, if there is information about other definitions, compare them.

Practice/ Question

- if any comment and/or question.

2.2 How to create the Hazard map in the pilot area

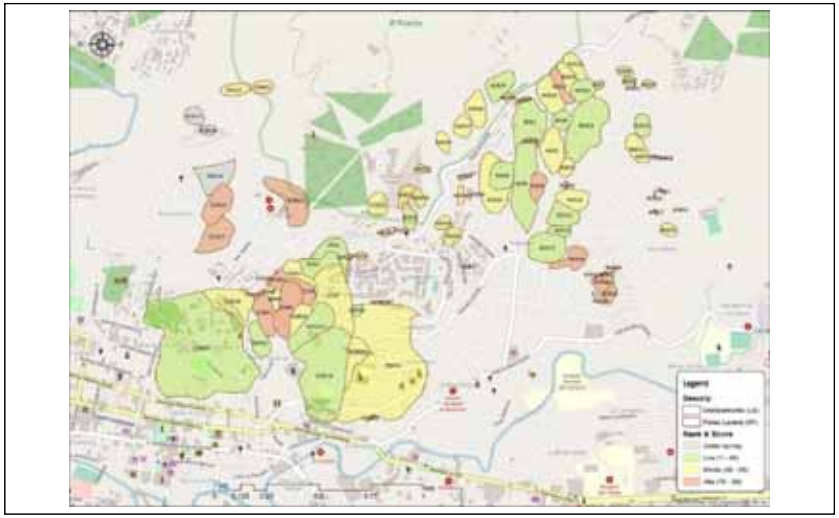


Figure 2.2. Hazard map in the process of creation

Explanation

- Ranking the results of field investigation using check sheets and compiling them on a map.
- Red coloured area indicates the Rank 1, yellow coloured area indicates the Rank 2, and green coloured area indicates the Rank 3 (Table 1, p.2).

Comments

- It is easy to identify hazard area, if the scale of the hazard map is small.

Practice/ Question

- If there is something to protect as a public property in and around the areas colored red and yellow, please provide the location and examples.

2.3 How to create the Risk map in the pilot area

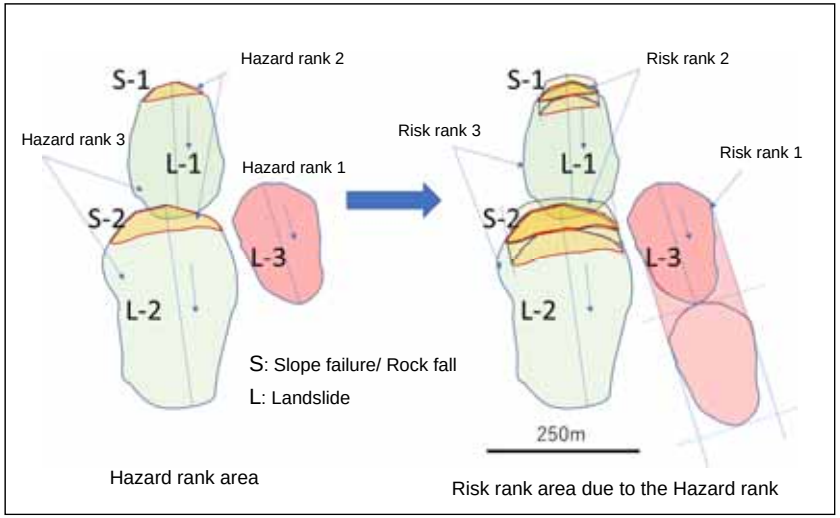


Figure 2.3. Basic way of creating the Risk map from the Hazard map in this project

Explanation

- Rank 1 (red) and Rank 2 (yellow) in the hazard category are the same category for creating a risk map.
- In the case of "Slope failure/ Rock fall", the horizontal distance is 10m upward from the upper end of the slope, and the same distance as the height of the slope runs downward.
- In case of “landslide”, the same length as the landslide block is set as the range moved downward (Figure 2.3). However, the length of the landslide area moves downward shall be less than 250 m.

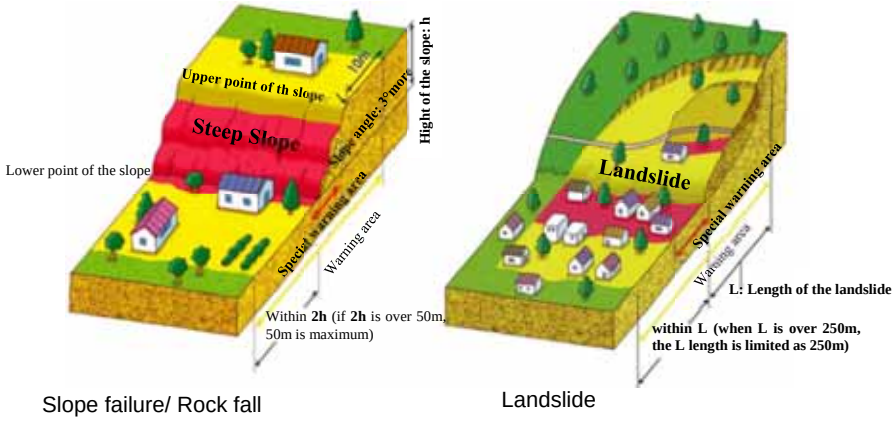
Comments

- The determination of the area of risk is referred on Japan's “Slope Disaster Prevention Law” (Appendix 7, p.16).

Practice/ Question

- if any comment and/or question.

Appendix 7: Hazard zones of “Slope failure/ Rock fall” and “Landslide” due to Japan’s “Slope Disaster Prevention Law”



Slope failure/ Rock fall　　Landslide

Yellow zone is defined as follows:

[Slope failure/ Rock fall]

- Areas with a slope of 30 degrees or more and a height of 5 m or more.
- Area within a horizontal distance of 10 m from the top of a steep slope.
- An area within 2 times the height of the steep slope (area 50m above is 50m limited) from the bottom of the steep slope.

[Landslide]

- Landslide area (a landslide area or a range of landslide risk).
- Area within the distance from the lower edge of the landslide area to the length of the landslide mass (250m if it exceeds 250m).

◆ Hazard zone (yellow zone): Areas to be informed of danger and to develop a warning and evacuation system to prevent and mitigate damage caused by slope disasters.

◆ Special hazard zone (red zone): It is particularly necessary to regulate the facilities from the development stage in order to prevent new facilities for people requiring attention who are required to evacuate from being located in areas with high risk of Slope disasters. Areas where restrictions are imposed such as permitting certain development activities and structural regulations for buildings, etc.

3. Basics of GIS

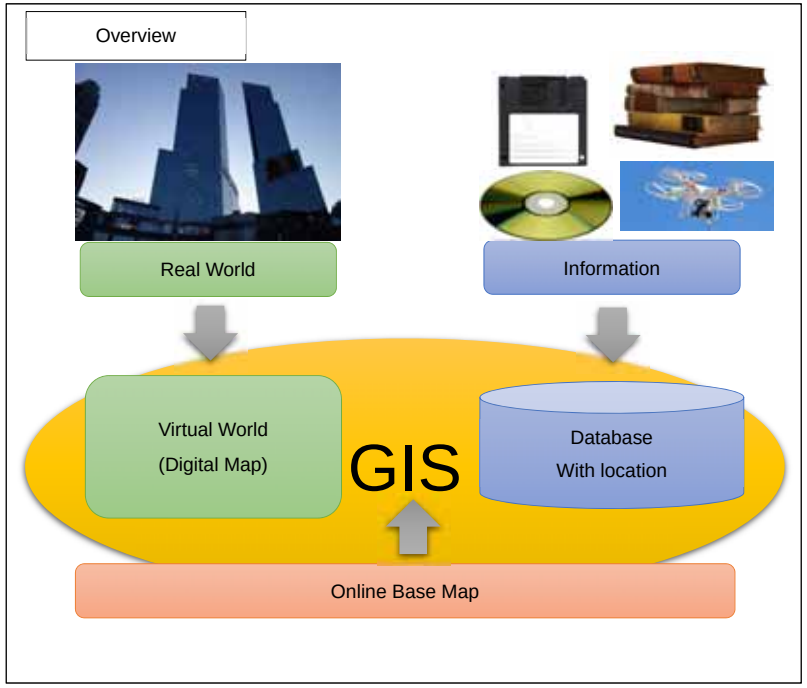


Figure 3.1. Overview of GIS

Explanation

- GIS (Geographic Information System) is a computer system to manage and handle information which distribute spatially. The information consists of “spatial location” and “attribute information”. Some people think that GIS is a tool for mapping some information. But GIS can analyze several kinds of data by registering, editing, integrating.
- If we have a hard copy of map with geographic coordinate, we can scan it and register it in GIS.
- If we have any digital information with geographic coordinate, we can import as a geographic layer.
- If we have any digital information related to some location, we can integrate it as attribute table or link it to geographic features.
- As a background of map, Online Base Map is used if we can connect internet.

3.1 How to register data for Hazard Map on GIS

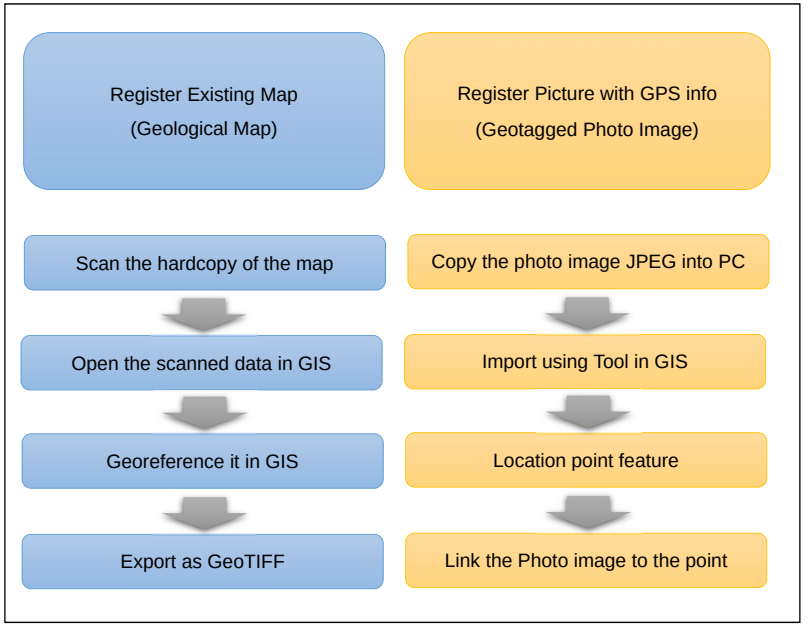


Figure 3.2. Flow of registration of map / information

Explanation

- First, we have to start basic condition of GIS, that is, GIS is a computer system, but it does not have any data in its initial setting. Thus, we usually start to register some geographic information into GIS for some purpose. One of the important information for landslide and slope failure is Geological Map. A simple procedure starting from hardcopy of Geological Map is shown in the above left flow.
- In the same time, we sometimes take pictures using smartphone or digital camera with GPS at field surveys. If you have such digital image with GPS information, GIS can import the location of the picture is taken. The right part shows the procedure.
- In the next page, we introduce ArcGIS interface for Georeferencing of Geological Map to find out geological feature at sites. Start line is usually a hardcopy of the map. We scan it to handle the map in PC. Next, we put X, Y coordinate values at four corners of the map and makes it more useful digital map.

Practice / Question

- Explain how you digitize slope failure location in GIS after field work. What kind of preparation do you need?

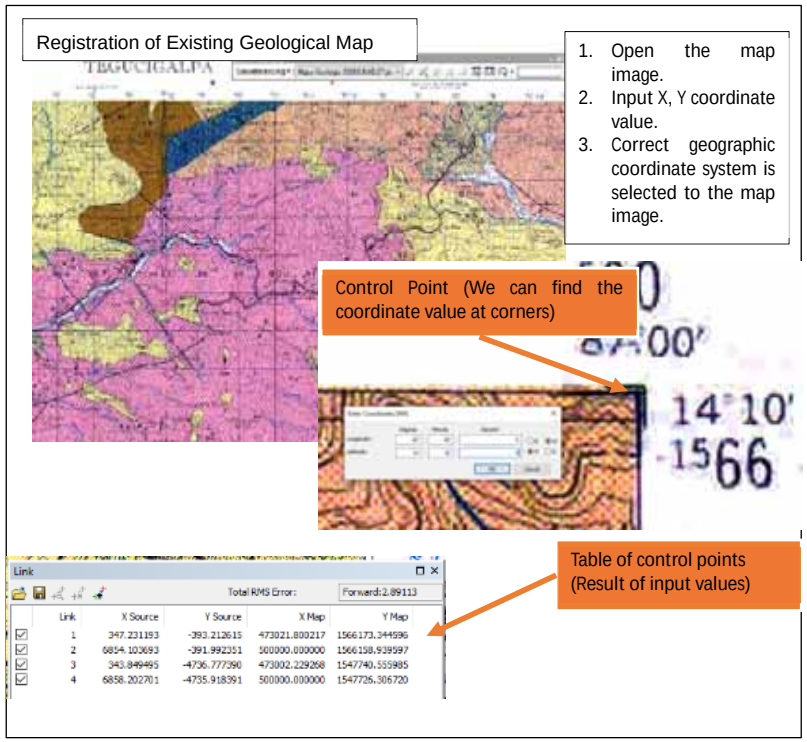


Figure 3.3. Registration of existing geological map

Explanation

- One of the most useful tools, since there is a lot of information generated in the NAD27 coordinate system which is one of the popular Datum in north and central US continent, is Georeferencing maps.
- In the course the georeferencing of the above geological map was practiced with the use of the Georeferencing tool.
- To perform georeferencing, control points must be defined and assigned with the georeferencing tool.
- Most important part in georeferencing tool is how to handle in the case of overlaying layers with different Datum. Please imagine that vector layers are based on WGS84 in the map window, but the georeferenced geological map is based on NAD27. GIS usually has parameters for “geographic transformation” to convert NAD27 to WGS84. In ArcGIS, it is defined as “NAD_1983 To_WGS_1984”. It is important work to reduce such gap of geographic errors by parameter settings, not edit or shift geographic data itself.

3.2 Data type on GIS

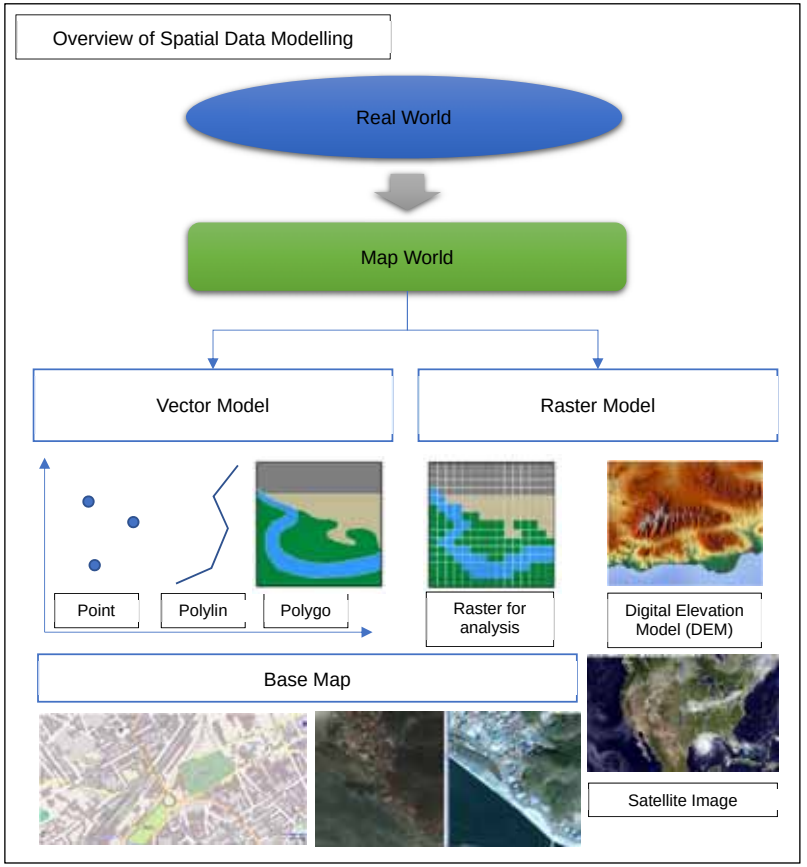


Figure 3.4. Flow of data modelling and data type

Explanation

- As the above figure shows, GIS data is separated into Vector and Raster. Vector type data consists of points, lines, polylines, or polygons. It shows pin-point location or border of the extent. Attribute table to each vector feature can save many kinds of text information.
- On the other hand, Raster type shows spatial grid cells with values and shows some surface feature, such as land use, topographic height, or aero photo image, etc. The grid value is simple one, but grid system enables raster layers to be analyzed.

Practice / Question

- Explain difference of Base map from other GIS data. How Base map is used?

3.3 How to register field survey result of GIS

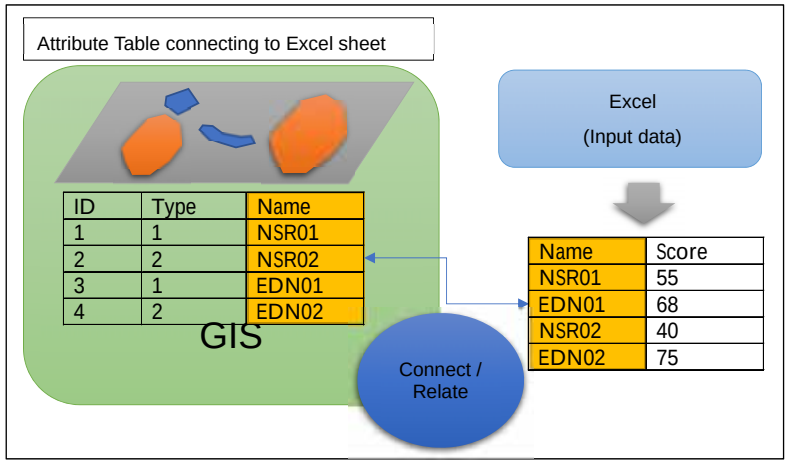


Figure 3.5. Connect / Relate of tables

Explanation

- Let us imagine that we input some score value into Excel sheet. GIS can identify the input data by Key field. In the above figure, Key field is Name. The polygon features have its original name and the data in Excel also has the name. Then both data table is easily connected by Key field “Name”.
- The format of data table should be database style with columns & lows. Column means data field determined as text or value. Low means data itself to each data field.
- One of the important tools of GIS is to Connect two Tables using key field. This is just like relational database, which has many relations with many data tables.
- In GIS after connecting two tables, original attribute table can obtain the additional data using “Field Calculator” by setting input field “Score”.

Practice / Question

- Fill the score value in the below table after connecting Score table.

ID	Type	Name	Score
1	1	NSR01	
2	2	NSR02	
3	1	EDN01	
4	2	EDN02	

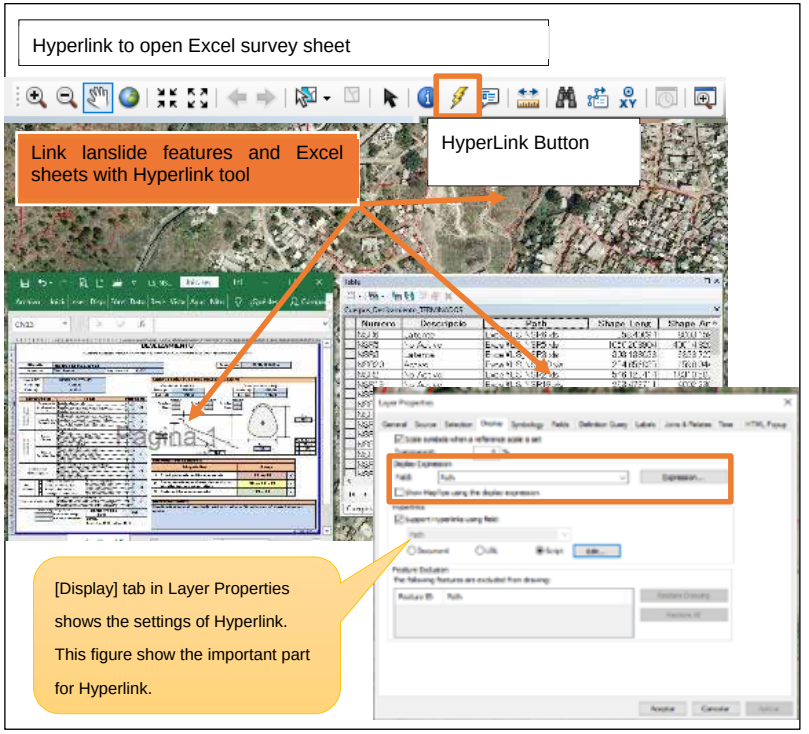


Figure 3.6. Hyperlink tool to open Excel sheet

Explanation

- Table connection is described in the previous page. It means connection of text / value data connection. But some data is photo image or data file like MS Word, Excel, etc. In such case, GIS can make link to the data files using “Hyperlink”.
- The above figure describes the tool image simply. Preparation is necessary to execute Hyper link. The steps are as follows.
  1. Data location is edited in Map Window and saved as vector features.
  2. Open attribute table of the vector feature and make “Path” data field.
  3. Edit relative data path in Path field to show the directory data of Excel sheet.
  4. Open [Layer Property] of the target layer and check on [Hyperlink] in [Display] tab.
  5. “Path” field is set for Hyperlink. Check on “Script” and edit the contents, if necessary.
- With the Display option of the layer properties you can enable the hyperlink option to open files linked to each element of the layer.

Practice / Question

- Explain the difference of “Connect / Relate” and “Hyperlink” tool in GIS.

3.4 Screening for slope failure

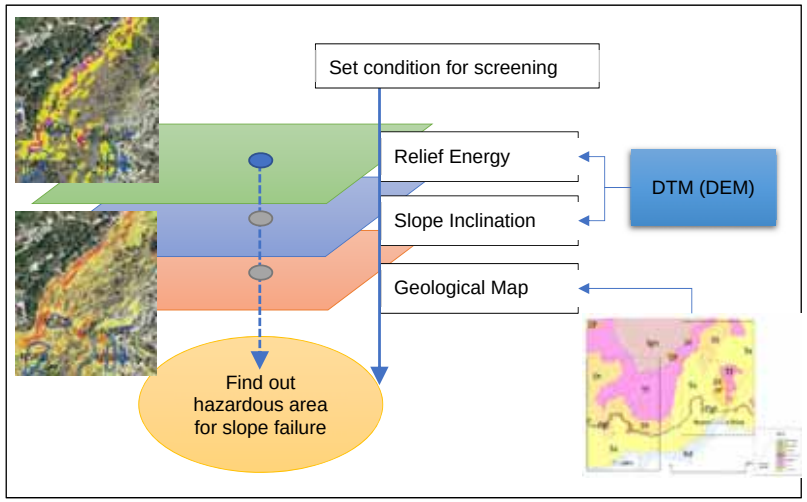


Figure 3.7. Flow of screening for slope failure

Explanation

- GIS can overlay several kinds of layers for a purpose. In Output 3 of the JICA Project, we aim at creating hazard map for landslide and slope failure & rock fall. After some technical discussion, three layers are chosen for the hazard map.

  1) Geological Map: It is a detailed geological feature in the pilot area, which is still on the way of digitizing for GIS. Original map was drawn by Dr. Hirota san by following previous project result.

  2) Slope Map: It is processed from DTM (DEM). It is raster layer with 0.5-meter grid cells. We also use contour layers generated from DTM (DEM) to understand the topographic features around the target area.

  3) Relief Energy Map: It is also processed from DTM (DEM). First 10-meter grid layer is prepared and pick up maximum and minimum value of DTM in each 10-meter grid cell. Then, Relief Energy is calculated as (maximum value – minimum value).

Practice / Question

- For screening of slope failure in whole Tegucigalpa using the above layers, which layer does it take more time to prepare? Discuss how should counterpart do for preparation after the JICA project.

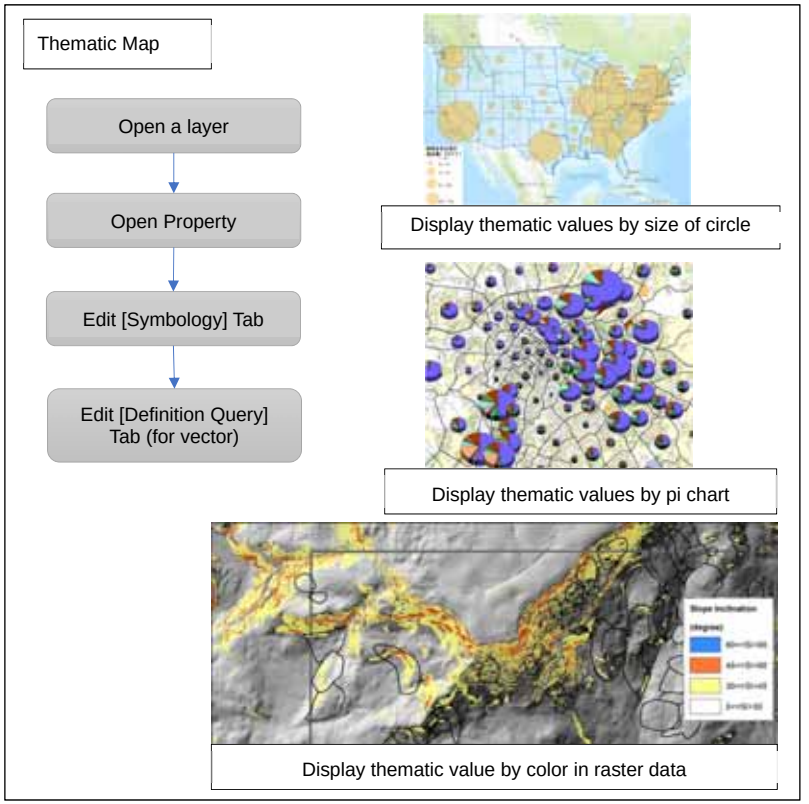


Figure 3.8. Flow of creating thematic map and examples

Explanation

- One of the most important tools in GIS is “Thematic Map”, in which data for a purpose is selected and/or colored, symbolized specific using attribute table information. And most thematic maps have base map of topographic, aero photo or satellite image as background. Both vector and raster layers can be target thematic layer.
- For overlaying some layers, we usually put some colors according to the attribute of the layer to appeal classification or some trend of values in the layer. The above left figure shows flow of creating thematic map. The bottom figure is an example of slope inclination map generated from DTM (DEM), in which separator is 30, 45, 60 degree.

Practice / Question

- Definition Query can select data on display using SQL. Show the SQL function which displays 10-meter interval from 2-meter contour line with attribute “Elevation”.

3.5 Basic tools to handle GIS data

《Introduction of ArcMap Window》

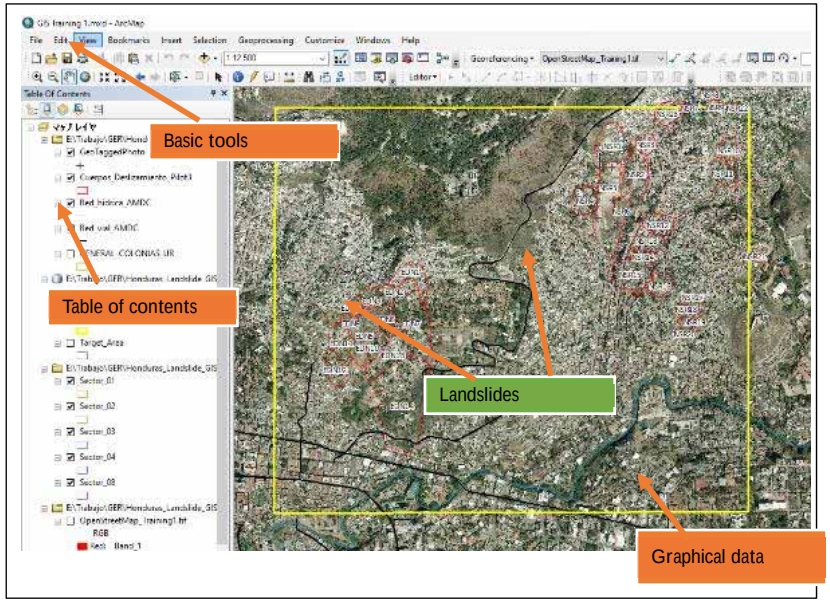
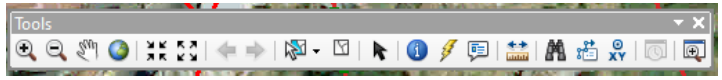


Figure 3.9. Introduction of ArcMap

Explanation

- It is a review of Basic Tools to handle GIS data. Although it is not necessary for intermediate users, it is essential for beginners to use GIS well, so I devoted pages to this part.
- We provide easy-to-understand content to get you started with ArcGIS Desktop from its most basic applications. At the same time, specific tools were provided to carry out the activities and analysis of result 3, within the framework of the Project.



- The tools bar helps us to modify the work view, select objects, see the information of each object, open hyperlinks, search and mark points by coordinates and, search for elements by name or descriptive attributes.

《Map Window》

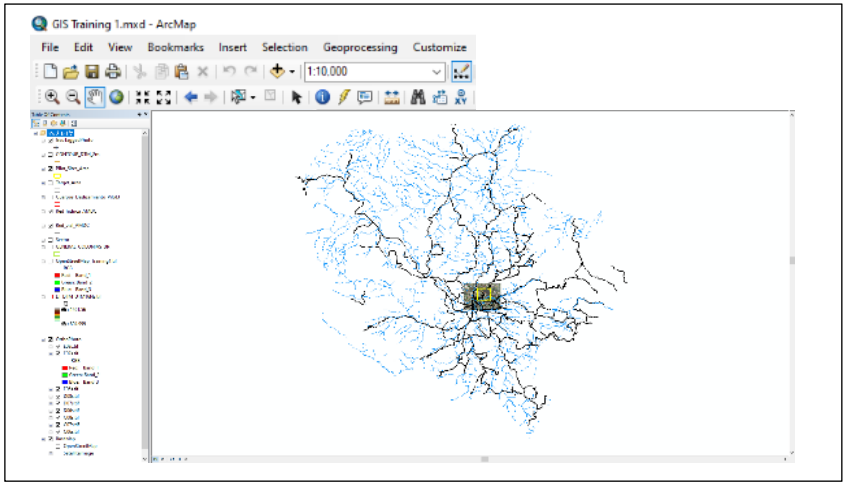


Figure 3.10. Introduction of ArcMap

Explanation

- We start with learning the most basic tools that help us visualize information with the support of some buttons.
- If you want to quickly view the total of all the layers contained, you must press the full extend icon  .

《Map Layer》

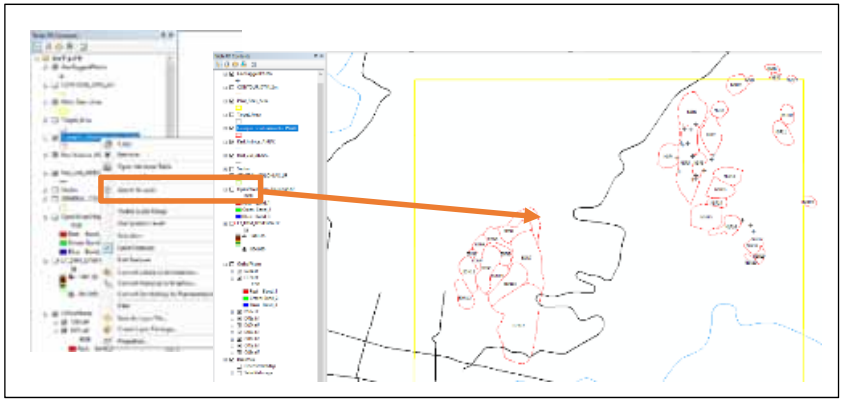


Figure 3.11. Map Layer and sub menu

Explanation

- If what you want to display a specific layer, you must search for the layer in the table of contents and right-click to select the "Zoom to layer" option.
- This option is very useful when you have many layers in the ArcMap project.

《Zoom In / Out》

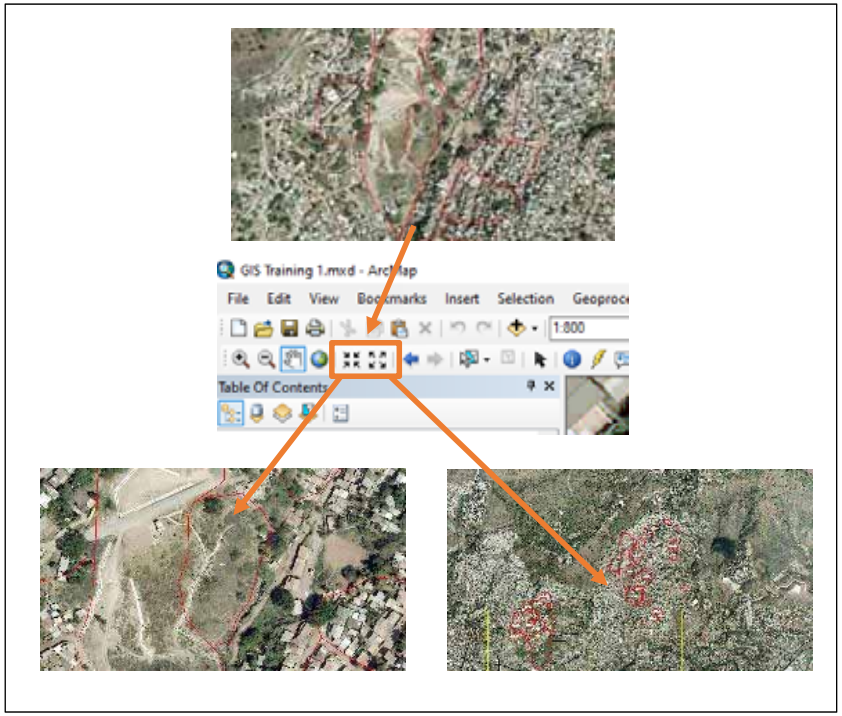


Figure 3.12. Zoom In / Out in fixed rate

- Other useful buttons for displaying graphic content are the zoom in and zoom out buttons. By using these icons, the focus of the image is enlarged or reduced respectively in fixed rate.

Practice / Question

- Explain how to use buttons. What is different from

《Panning》

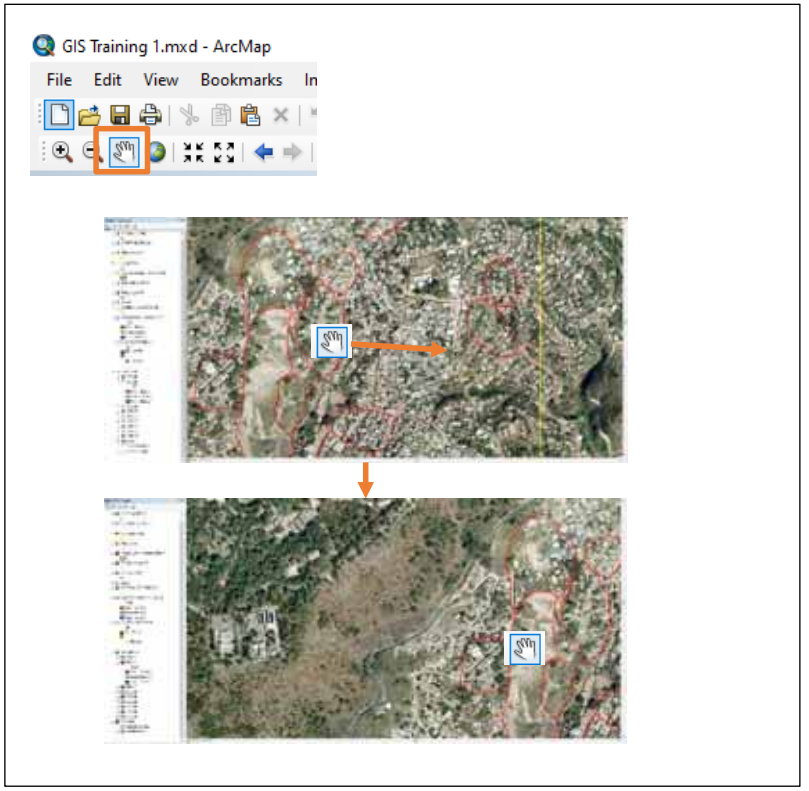


Figure 3.13. Panning tool

Explanation

- The pan icon helps us manipulate the view of the layers on the screen. You can move objects by holding a left click.

《Attribute Table》

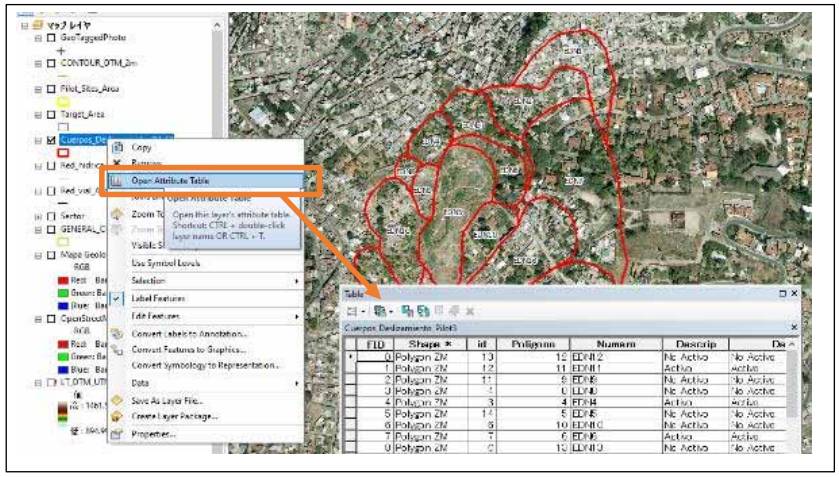


Figure 3.14. Open attribute table

Explanation

- In the attributes table you can know the database of a vector format layer. These data are qualitative and quantitative descriptions of each element in the layer.
- To access the attribute table, you must find the layer in the table of contents, right-click and select the option called "Open attribute table". Attribute Query is also important to select target data lows from the attribute table. Click table menu and select [Attribute Query]. Then you find a dialog box to fill SQL for selecting target dsata lows.

Agencia de Cooperación International del Japón

Honduras
Proyecto para el Control y Mitigación de Desastres en Laderas del Distrito Central

[Materiales de aprendizaje en casa]

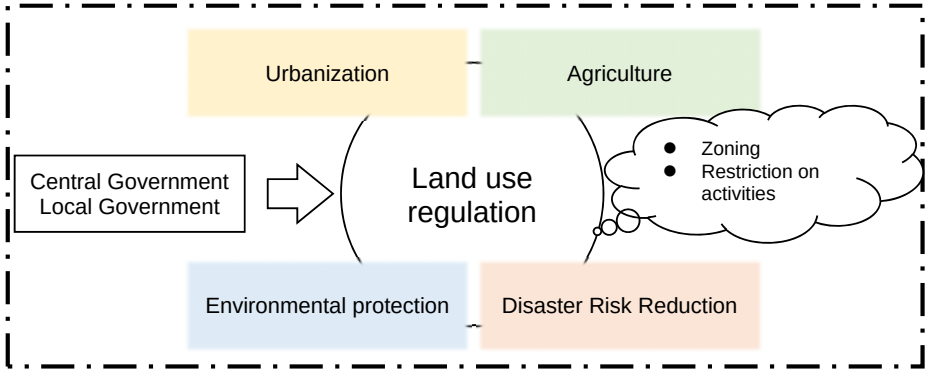
Resultado 4: Se fortalece la capacidad de regular el ordenamiento territorial en las áreas en riesgo de desastres en laderas

Junio, 2020

Tabla de contenido

1. Introuduction

1.1 What is land use regulation?



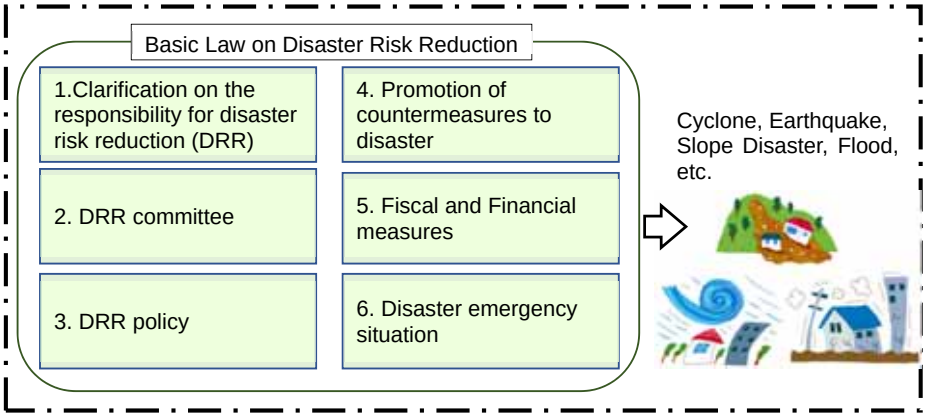
< Outline of land use regulation >

The Central Government or the Local government set up land use regulation when it is necessary to restrict some activities such as construction works in an area. Land use regulations are established based on laws related to urbanization, agriculture, environmental protection, Disaster Risk Reduction or other fields. Each law defines the regulated zone by establishing rule such as license system for land use.

< Example of land use regulation in Japan >

1. **Urbanization:**
   - The City Planning Law specifies 12 zones of land use in order to conduct efficient urbanization by defining the purpose of land use in each zone.
   - In each zone, the type and maximum floor space of building are restricted.
2. **Agriculture:**
   - The Agricultural Development Law defines the “Agricultural Promotion Zone” in order to conserve farmlands and use them effectively.
   - Only agriculture activity is allowed. Changing the purpose of land use to other type is not allowed.
3. **Environmental protection:**
   - The Natural Environment Protection Law defines the “Environmental Protection Zone” in order to conserve natural environment from development activities.
   - Permission system is applied for specific activities in the “Environmental Protection Zone”.
   - Activities such as construction of artificial structure, planting tree, releasing animal and other activities affecting environment are prohibited in the “Environmental Protection Zone”.
4. **Disaster Risk Reduction for slope disasters:**
   - The Slope Disaster Prevention Law or other laws related to slope disasters specify the “Slope Disaster Hazard Zone”, the “Erosion Prevention Area”, the “Landslide Prevention Area”, and the “Slope Failure/Rockfall Prevention Area” in order to protect lives and property from the slope disasters.
   - In these zones, the prevention works such as implementation of countermeasure works, license system to Specific Land Development are conducted.

1.2.1 Laws related to Disaster Risk Reduction in Japan - Basic Law on DRR

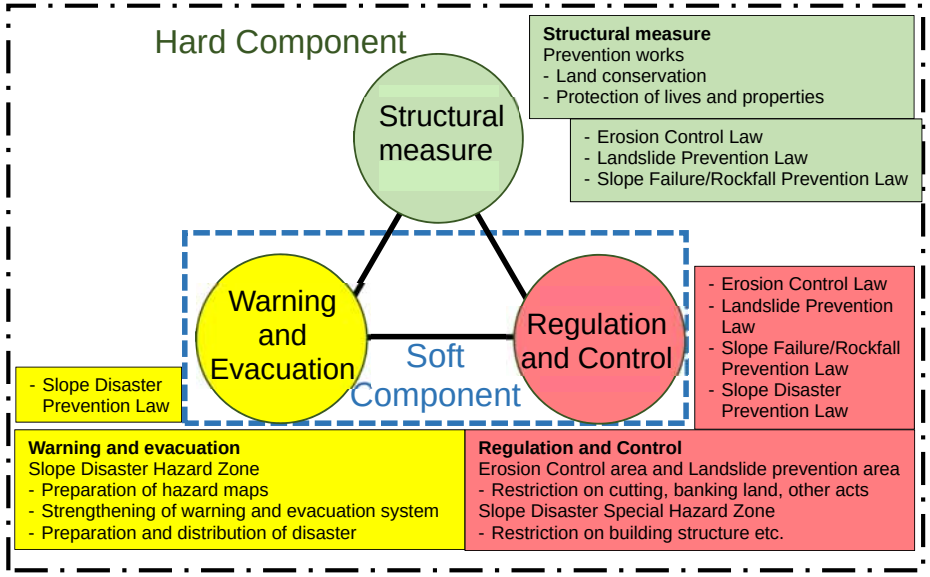


< Background and purpose >

The Basic Law on Disaster Risk Reduction was enacted in 1964. This is basic law for disaster prevention actions in Japan so that the Central Government and the Local Government can carry out activities on disaster risk reduction (DRR) effectively. It aims to protect the lives and property from any type of disaster by clarifying the role and responsibility of the Central Government and Local Government and establishing DRR committee and DRR policy in the governments. This law is composed of 6 main elements.

1. **Clarification of responsibility for DRR:** The Central Government and Local Government are responsible for preparing and implementing DRR policy. Residents are also responsible to voluntarily participate in disaster prevention activities.
2. **DRR committee:** DRR committees are organized in both of the Central Government and Local Government in order to take actions on DRR in each level. In case of a disaster, the Local Government establishes the Operation Center for disaster response.
3. **DRR policy:** DRR committee of the Central Government establishes the Basic DRR policy. Based on the Basic DRR policy, the Local Government sets up a Local DRR policy.
4. **Promotion of countermeasures to disaster:** The DRR committee take necessary measures for prevention and reaction of disasters.
5. **Fiscal and Financial measures:** For severe disasters, the Central Government provides special financial assistance to the Local Government.
6. **Disaster emergency situation:** In the case of a catastrophic disaster that affects the national economic and social situation, the Prime Minister can issue a declaration of emergency and establishes the Emergency Operation Center of the Central Government.

1.2.2 Laws related to Disaster Risk Reduction in Japan - Laws related to slope disasters



In order to protect lives and properties from slope disasters, 3 types of preventive measures are taken in Japan:

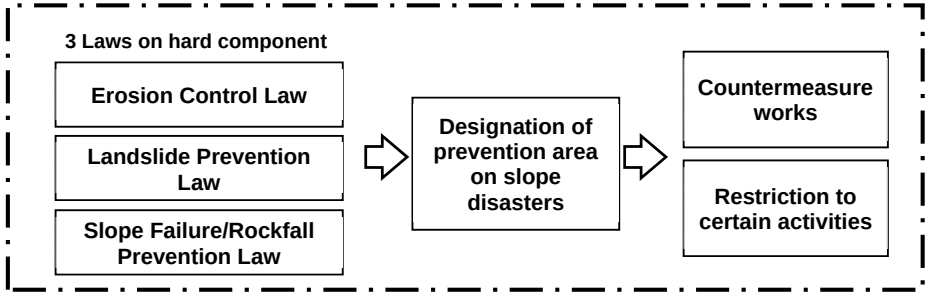
- Structural measures: Construction of building facilities and artificial structures
- Warning and Evacuation: Establishment of a system for warning/evacuation etc.
- Regulation and Control: Regulating and control of new construction and land use

Against slope disasters, there are laws related to hard component such as construction of countermeasures (Erosion Control Law, Landslide Prevention Law, Slope Failure/Rockfall Prevention Law). The soft component is regulated on 4 laws of the Slope Disaster Prevention Law (SDP Law) in addition to the above mentioned 3 laws in Japan.

The land use regulation established through the Project is in relation to SDP Law in Japan. Compared to the laws in hard component, the SDP Law aims to:

- Promote measures in soft component
- Be linked to license system or inspection of building structure
- Expect that the Local Government provides disaster information to residents and that the local residents acquire the information.
- Protect lives and properties by license system for Specific Land Development or Restriction on building structure.

1.2.3 Laws related to Disaster Risk Reduction in Japan - Laws related to hard component



The 3 laws on the hard component have been historically developed in the Disaster Risk Reduction in Japan. The outline of the 3 laws on the hard component is as follows.

< 3 Laws related to hard component >

1. Erosion Control Law (1897)

- Prevent damages caused by all slope disasters
- "Erosion Prevention Area" defined by the Minister of Land and Infrastructure

2. Landslide Prevention Law (1958)

- Eliminate or mitigate damage caused by landslides
- Contribute to conservation of lives and properties
- "Landslide Prevention Area" defined by the Minister of Land and Infrastructure

3. Slope Failure/Rockfall Prevention Law (1968)

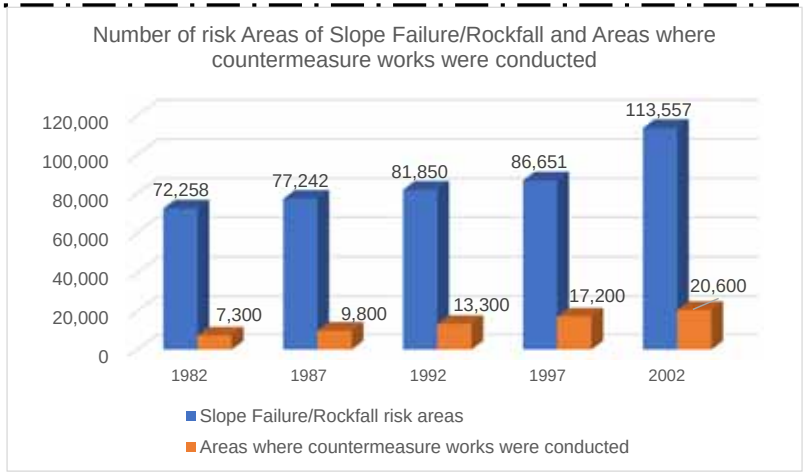
- Protect lives and properties from slope failures and rockfall,
- Area with slope 30 degrees or more defined as a "Slope Failure/Rockfall Prevention Area" by the governor[1] of Local Government.

In the Prevention Areas described in the 3 laws, the erosion control or other prevention works against the landslides, slope failures/rockfalls are required. And certain actions must be prohibited or restricted. In order to conduct the activities listed below, permissions from the Local Government are needed.

Erosion Prevention Area	Landslide Prevention Area	Slope Failure/Rockfall Prevention Area
- New construction, renovation of facilities or works - Cutting, embankment, and excavation of land - Mining, sedimentation and dumping of debris, - Felling or burning plants, etc.	- Drawing or stagnating groundwater, - Stopping functions of groundwater drainage - Stagnating surface water, etc.	- Discharging or stagnating surface water, - Installing or modifying drainage facilities, - Cutting, embankment, excavation of land - Felling trees, etc.

[1] Slope Failure/Rockfall Prevention Area is defined by the governor of the Local Government because the implementer of prevention works in this Area is different from other 2 Prevention Areas. In the Slope Failure/Rockfall Prevention Area, the prevention works are conducted by a landowner. The Local Government implements prevention works if the landowner is not able to implement them. In other 2 Prevention Areas, erosion control or other prevention works are implemented by the Local Government.

1.3.1 Slope Disaster Prevention Law - Histrical background



< Background >

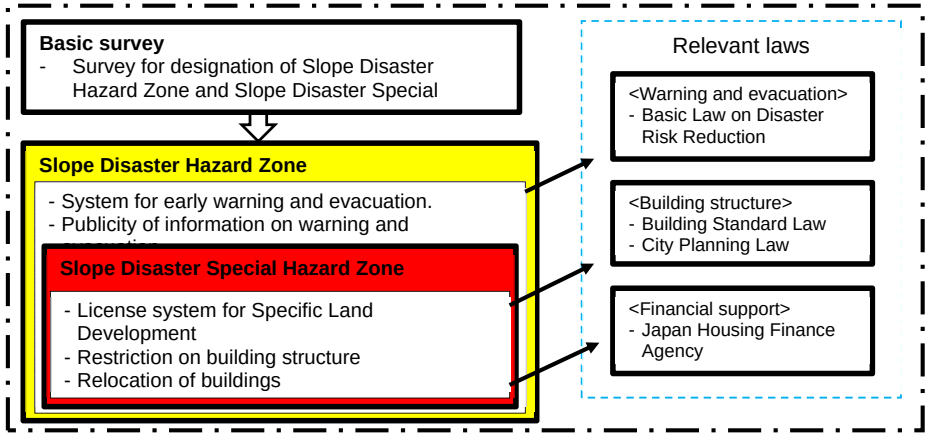
Slope disasters occur every year in Japan and have given impact on human lives. On the other hand, new residential areas continue to expand without doing any countermeasure works. The number of risk areas of slope disaster continue to increase in Japan, but the countermeasure works have been carried out in only 20% of those areas. It takes a huge amount of time and financial resources to carry out countermeasure works in all the areas with risks.

There was the heavy rain disaster that occurred in 1999 in Japan. Heavy rain brought about debris flow at 139 locations and landslides at 186 locations in whole Japan, which caused 31 dead, 1 missing, and 154 houses destroyed. In this background the Slope Disaster Prevention Law (SDP Law), which is a law related to soft component, was established in 2000, in addition to hard component such as construction of countermeasure works.

< Purpose >

The SDP Law aims to protect lives and properties from slope disasters by clarifying the zones with a risk of slope disasters and promoting measures in soft component such as awareness, establishment of a warning/evacuation system in community, as well as land use regulation such as restrictions to new constructions and relocation of existing houses.

1.3.2 Slope Disaster Prevention Law - Content of the Slope Disaster Prevention Law



The Slope Disaster Prevention Law identifies the zones where slope disasters may occur and establishes a warning/evacuation system and apply land use regulation according to the hazard zones.

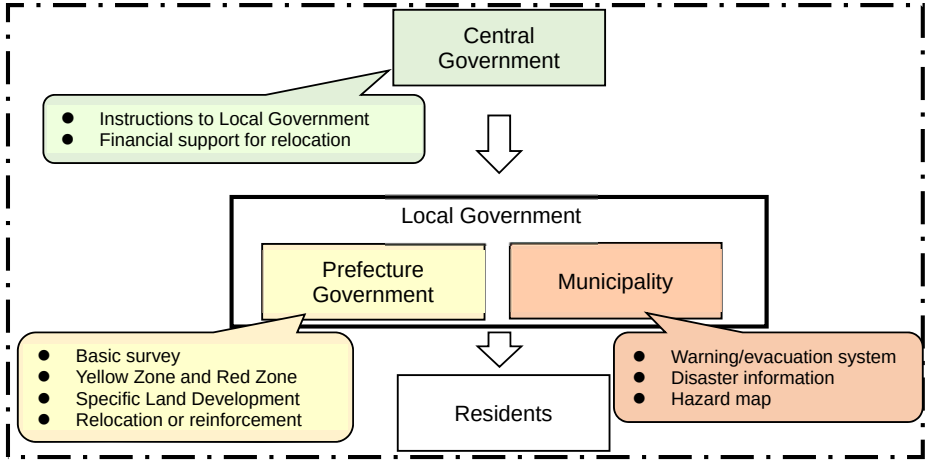
< Contents of the law >

1. **Basic survey:**
   - Survey to designate Slope Disaster Hazard Zone and Slope Disaster Special Hazard Zone
2. **Designation of Slope Disaster Hazard Zone and Slope Disaster Special Hazard Zone:**
   - Slope Disaster Hazard Zone (Yellow Zone): Zone where the lives and properties may be harmed in case of slope disaster
   - Slope Disaster Special Hazard Zone (Red Zone): Zone in the Yellow zone where lives and properties may be lost in case of slope disaster
3. **System for early warning and evacuation:**
   - Information and warning/evacuation system in the local DRR policy
   - Communication system for people requiring assistance in case of disaster
   - Hazard map
4. **License system for Specific Land Development[2]:**
   - License issued by the Local Government
   - Construction of countermeasure works prior to the Specific Land Development
5. **Restriction on building structure:**
   - Reinforcement and inspection for building structure
6. **Assistance for those who relocate:**
   - Financial support for relocation of local residents by the Central and Local Governments

[2] The Specific Land Development (SLD) is the construction works allowed in the Slope Disaster Special Hazard Zone (Red Zone) in Japan. To conduct the SLD, a license issued by the Local Government is required. The example of SLD is a construction of social welfare facilities, schools, and medical centers etc.

2. Land use regulation in Japan

2.1 Relationship between the Central Government and the Local Government



The Slope Disaster Prevention Law (SDP Law) clarifies the responsibilities of the Central Government, the Prefecture Governments, and the Municipality in reaction for slope disasters.

1. Central Government, led by the Minister of Land and Infrastructure

- Establish a basic guideline for prevention of slope disaster and give instructions to the Local Government in slope disaster responses
- Request the Prefecture Government to submit the result of basic survey
- Provide financial support to the residents for relocation

2. Prefecture Government

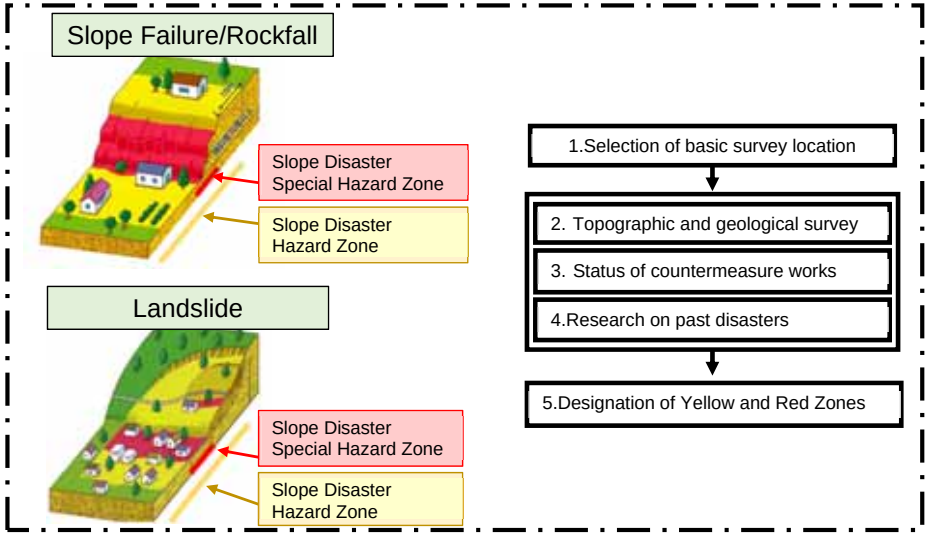
- Implement the basic survey and designate the Slope Disaster Hazard Zone (Yellow Zone) and Slope Disaster Special Hazard Zone (Red Zone)
- Notify the Municipality of the determination of the Yellow and the Red Zone
- Give a permission to those who conduct a Specific Land Development (SLD) in Red Zone
- Recommend residents in Red Zone to take necessary reinforcement of buildings or to relocate

3. Municipality

- Establish a warning/evacuation system and give evacuation instructions to residents
- Collect the disaster information related to slope disasters and provide them with residents
- Set up a communication system for facilities for people who need support in case of slope disasters (such as hospitals) in the Yellow Zone or the Red Zone
- Create a hazard map

In general, the Prefecture Government and the Municipality provide concrete actions to residents. The Central Government plays a role in assisting the Prefecture Government and Municipality.

2.2.1 Designation of Hazard Zone - Basic survey



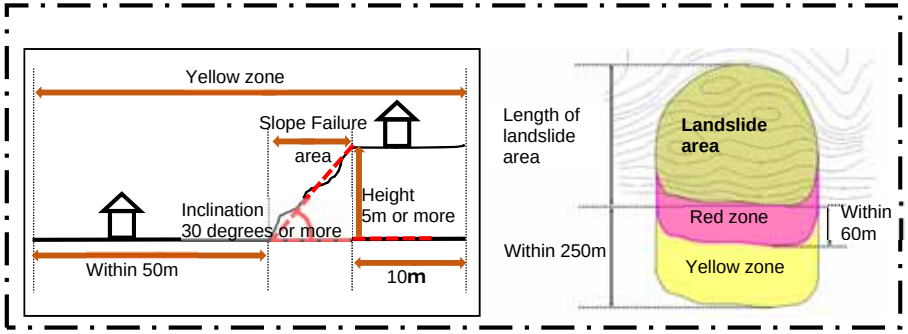
In Japan, high risk areas of slope disaster are defined as Slope Disaster Hazard Zone (Yellow Zone) or the Slope Disaster Special Hazard Zone (Red Zone) in order to regulate the land use. The Local Government conducts a basic survey to determine the Yellow Zone and the Red Zone.

Zone	Definition
Slope Disaster Hazard Zone	Zone where the lives and properties may be harmed in case of slope disaster.
Slope Disaster Special Hazard Zone	Zone in the Yellow Zone where the lives and properties may be lost in case of slope disaster.

The Local Government conducts the basic survey every 5 years in the high risk areas of slope disasters. The type of disasters covered by the Slope Disaster Prevention Law is Slope Failure/Rockfall, Landslide, and Debris Flow. The designation of the Yellow Zone and Red Zone is conducted through the 5 steps as follows.

1. Selection of basic survey location

Type	Condition	Standards
Slope Failure/Rockfall	Topographic	- Area with inclination of 30 degree or more and height of 5m or more
	Social	- Area where houses are located on a slope and its surroundings. - Locations where houses are expected to be located in the future.
Landslide	Topographic	- Landslide area - Area where there are signs of landslides (cracks, depression, bumps etc).
	Social	- Area where houses are located in landslide area and its surroundings. - Locations where houses are expected to be located in the future.



2. Topographic and geological survey

The following items are checked through desk and field research. The field research is conducted at lower area of slope to distinguish small characteristics that are hard to find in desk research.

- Topology, geology, precipitation, land use, expected range of slope disaster
- Small hills, embankments, rivers and waterways
- Artificial structures such as roads that are formed by excavation and embankment works

In addition, the following topics are considered for each disaster types.

Slope Failure/Rockfall	Landslide
Inclination of slope	Direction of landslide
Height of slope	Length of landslide
	Width of landslide

3. Status of countermeasure works

- Types of countermeasure works and period of construction,
- Effectiveness of countermeasure works

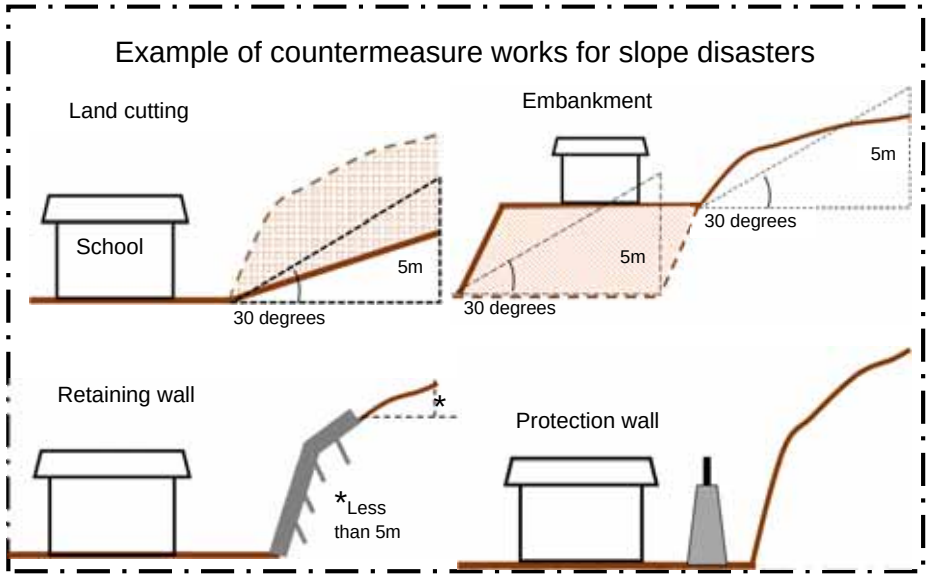
4. Research on past disasters

Scale and damage caused by past slope disasters in or around the survey location.

5. Designation of Slope Disaster Hazard Zone and Slope Disaster Special Hazard Zone

The Yellow Zone and the Red Zone are designated according to the definition below.

Disaster type	Zone	Definition
Slope Failure/ Rockfall	Slope Disaster Hazard Zone	- Inclination of 30 degrees or more and a height of 5m or more. - Within a 10m from the top of slope. - Within 50m from the bottom of slope
	Slope Disaster Special Hazard Zone	- Included in the Yellow Zone - Artificial buildings destroyed because of Slope Failure/ Rockfall
Landslide	Slope Disaster Hazard Zone	- Landslide area - Within 250m from the bottom of slope
	Slope Disaster Special Hazard Zone	- Included in the Yellow Zone - Artificial buildings destroyed because of Landslide - Within 60m from the bottom of slope



< License required for Specific land development >

The Specific Land Development (SLD) is the construction allowed in the Slope Disaster Special Hazard Zone (Red Zone) in Japan. To implement SLD, a license issued by the Local Government and countermeasure works are required.

The SLD is construction of house and social welfare facilities, schools, and medical centers, centers for persons with disabilities etc.

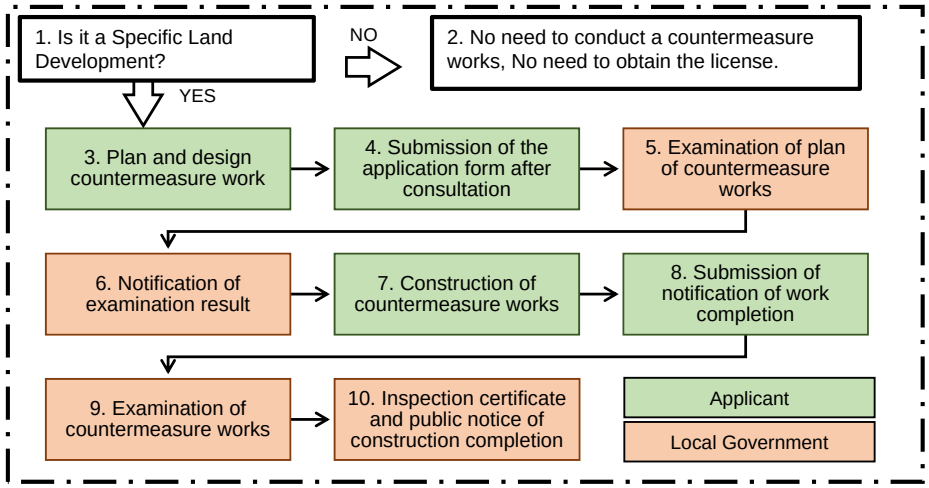
< Background of License system of Specific Land Development in Japan >

Residential areas have been expanded without countermeasure works even in high risk areas of slope disasters, and the number of people exposed to slope disasters have increased. For this background, the license for SLD was applied in order to protect the lives and properties in the high risk areas of slope disaster.

< Countermeasure works for Specific Land Development >

Depending on type of slope disasters (Slope Failure/Rockfall, Landslide etc.), it is necessary to construct countermeasure works prior to implementation of SLD. The Red Zone is deregulated in whole or partially under the condition of the construction of efficient countermeasure works.

2.3.2 License system for Specific Land Development - Application flow for SLD



The permission to conduct the Specific Land Development (SLD) is given according to the flow below.

<Flow of application for License for Specific Land Development >

1. Is it a Specific Land Development?, 2.No need to conduct a countermeasure works:

- Confirm whether the building to be built is SLD or whether the property where the SLD is conducted is inside of the Slope Disaster Special Hazard Zone
- Consider the building of unknown purpose as SLD

3. Plan and Design countermeasure work:

- Prepare plan and design taking type and location of countermeasure works into account

4. Submission of the application form:

- Consult about a plan and design of countermeasure works with the Local Government
- Advices and instructions about the plan of countermeasure works given by the Local Government

5. Examination of plan of countermeasure works:

- Check the application forms and the countermeasure works plan based on the technical standard

6. Notification of examination result:

- Give safety instructions related to the implementation of construction if it is approved

7. Construction of countermeasure works:

- Notification of work commencement submitted to the Local Government
- Placard showing approval for implementation of SLD at the construction site.

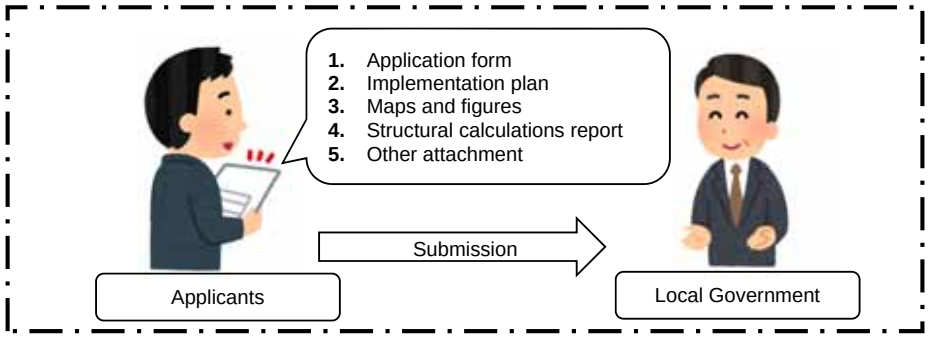
8. Notification of work completion, 9. Examination of countermeasure works:

- Notification of work completion submitted to the Local Government after the construction
- Inspection of the countermeasure work and issue of inspection certificate by the Local Government

10. Public notice of certification of construction completion:

- Certification of construction completion notified in order to start SLD

2.3.3 License system for Specific Land Development - Application form



Those who plan to implement a Specific Land Development (SLD) submit the following documents and plans to the Local Government.

1. Application form:

1	Location and size of SLD	5	Outline of implementation plan of SLD
2	Purpose of SLD	6	Date when the construction of countermeasure work starts
3	Detailed location of SLD in the property.	7	Date when the construction of countermeasure work ends
4	Outline of implementation plan of countermeasure works		

2. Implementation plan of countermeasure works:

1	Plan of countermeasure works	4	Land use plan
2	Current situation of zone with a risk of slope disasters	5	Maintenance of countermeasure works
3	Current situation of land use	6	Schedule and work flow of construction of countermeasure works

3. Maps and figures: The following maps and figures are necessary to be submitted.

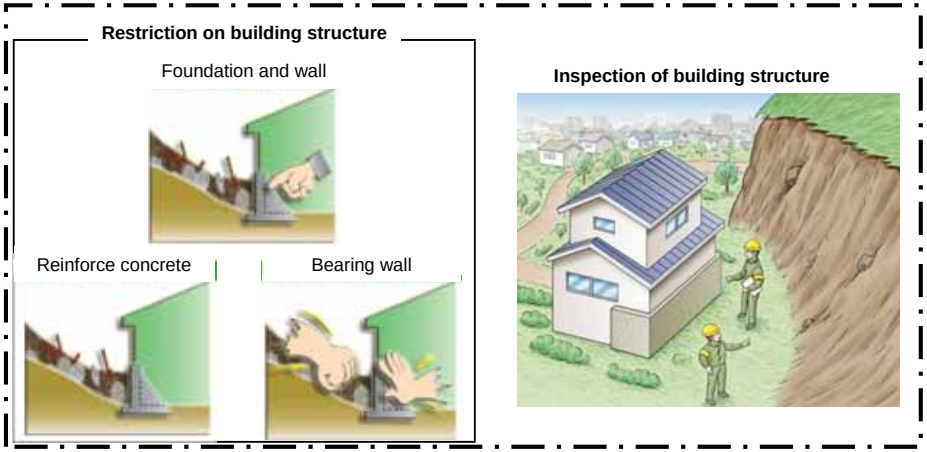
Maps and figures	Necessary information
Topographic map	Topography, range of hazard zones, SLD zone, position and type of countermeasure works
Land use plan	Range of SLD zone, shape of property, position of SLD.
Construction plan (Plan and cross-section)	Position and type of countermeasure work, range of SLD zone, surface before and after countermeasure works
Design of countermeasure works (Plan and cross-section)	Location and type of countermeasure works surface before and after countermeasure works
Structural drawing	Type and structure of countermeasure works

4. Structural calculations report

5. Other attachments:

- Residential map and acceptance from stakeholders

2.4.1 Restriction on building structure - Outline of restriction and inspection of building structure



In the Slope Disaster Prevention Law, those who construct a building in the Slope Disaster Special Hazard Zone (Red Zone) should ensure the building structure. The Local Government restricts and inspects the building structure in order to avoid the demolition due to slope disasters.

<Outline of restriction of building structure >

- Restriction on construction method and inspection of building structure in the Red Zone
- Target: Construction works such as new construction, extension and reconstruction of building
- Confirmation on construction method such as thickness of wall, depth of foundation, rebar for reinforcement etc.
- Confirmation on reinforcement works to existing buildings by making a bearing wall or other protection works.

<Outline of inspection of building structure >

- Inspection by the Local Government before and after the construction in the Red Zone
- Before construction: Confirm whether construction plan conform to the Building Standard Law.
- After construction: Confirm whether the building is constructed as requested.

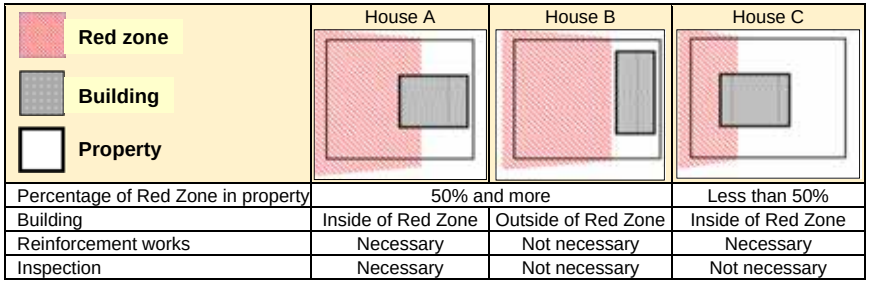
<Reinforcement of structure for slope disasters >

The building structure must be reinforced on the following points.

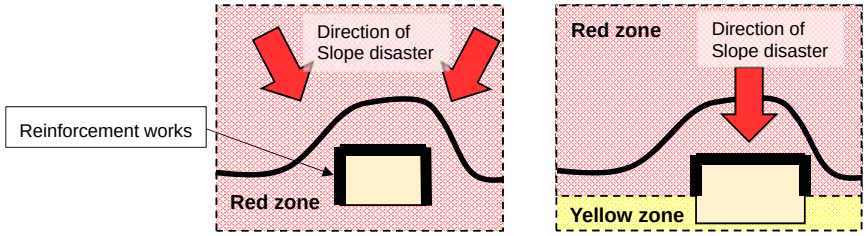
1. **To integrate the foundation and wall of buildings and wall**
   - Thickness of wall (15cm or more), depth of foundation (60cm or more)
2. **To make principal parts (foundation, pillars etc.) of building structure by reinforce concrete**
3. **To construct bearing wall by reinforce concrete in the part facing the slope**
   - Rebar (ϕ9mm or more) at 30cm interval

2.4.2 Restriction on building structure - Range of restriction and inspection of building structure

Range of restriction and inspection of building structure



Percentage of Red Zone in property	50% and more		Less than 50%
Building	Inside of Red Zone	Outside of Red Zone	Inside of Red Zone
Reinforcement works	Necessary	Not necessary	Necessary
Inspection	Necessary	Not necessary	Not necessary



The restriction and the inspection of building structure are applied to new construction in the Slope Disaster Special Hazard Area (Red Zone) as well as extension or reconstruction works for existing buildings.

< Range of restriction and inspection of building structure >

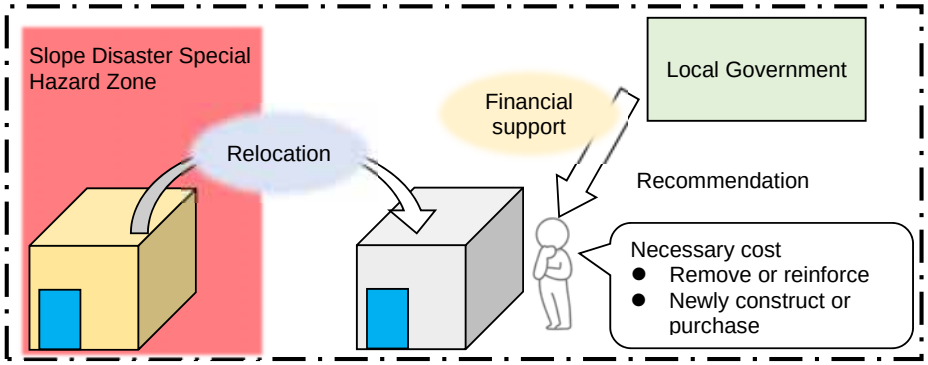
The range of restriction and inspection of building structure differs depending on the proportion of the Red Zone in property.

- If 50% and more of property is occupied by Red Zone, and part or all of the building to be newly constructed, expanded, or reconstructed is included in the Red Zone, the restriction and the inspection is needed. However, if the building is outside of the Red Zone, the restriction nor the inspection is not necessary.
- If less than 50% of property is occupied by Red Zone, and part or all of the building to be newly constructed, expanded, or reconstructed is located in the Red Zone, the restriction is applied to reinforce the structure. But the inspection is not performed.

<Reinforcement works for specific part of building>

- Reinforcement works are carried out for foundation and wall of building which face the slope

2.5 Recommendation for relocation and financial support



<Outline of recommendation for relocation or reinforcement>

The Local Government recommends the residents in the Slope Disaster Special Hazard Zone (Red Zone) to relocate from the Red Zone or to conduct reinforcement works for existing buildings.

The purpose of the recommendation is to urge the residents in the Red Zone to take necessary prevention action against slope disasters. The Local Government also helps the residents to acquire a new land.

<Financial support for relocation or reinforcement>

The Local Government are able to provide financial support to those who relocate from the Red Zone or reinforce existing buildings in the Red Zone. This financial support is only for the cost related to relocation work such as removal, acquisition of new land etc, not for compensation even though the property value declines due to determination of the Red Zone.

<Financial support for relocation>

1. **Loan from the National Housing Finance Agency**[3]
   - Relocation from the Red Zone and construction of new building: Up to 165,000USD
   - Acquisition of new land title: Up to 95,000USD
   - Purchase of new house: Up to 265,000USD
2. **Finance support from the Local Government**
   - Grant to relocate the building and property from the Red Zone: Up to 9,500 USD.
   - Grant to acquire a new land, or construct/purchase a building in new land: Up to 20,000 USD
   - Grant for amount of borrowing interest rate in case that the residents borrow the money from bank in order to acquire a new land or construct/purchase a building: Up to 40,000 USD

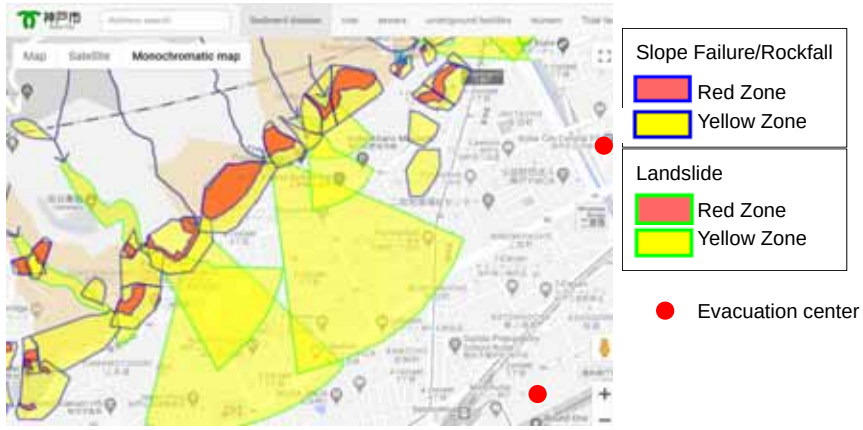
<Financial support for reinforcement from the Local Government>

- Grant for installation of bearing wall, fence or gate: Up to 7,500USD

[3] The National Housing Finance Agency was established in 2007 as a government organization in Japan. The purpose is to contribute to social welfare of the residents by lending the funds for constructing/purchasing houses.

2.6 Hazard map

Example of hazard map for slope disasters in Japan



< Creation of Hazard map >

According to the Slope Disaster Prevention Law, the Local Government establishes a waring/evacuation system. A hazard map for slope disaster created by the Local Government is distributed to the residents and is also published on the Internet so that the residents can easily access information on slope disasters. When creating a hazard map, the Local Government takes opinions from the residents into account.

< Content of Hazard map >

A hazard map for slope disasters shows the range of Slope Disaster Hazard Zone (Yellow Zone) and the Slope Disaster Special Hazard Zone (Red Zone) as well as type of disasters (Slope Failure/Rockfall or Landslide). The following contents are also included in hazard map for slope disaster.

1. **Communication tools related to slope disasters between the Local Government and residents to share disaster information each other**
   - Normal time: Information related to slope disasters on the Internet
   - Time of disaster: Radio for disaster prevention, siren, telephone, etc.
2. **Evacuation center**
   - Information on evacuations centers such as name, address, telephone number etc.
3. **Other information necessary for smooth evacuation**
   - Rainfall data, characteristics and sign of slope disasters etc.

2.7 Awareness activity to residents

Poster of the Slope Disaster Prevention Law

- Basic survey
- Range of Yellow zone and Red Zone
- Contents of regulation
- Contact to the Local Government

The Local Government informs the residents about Slope Disaster Hazard Zone (Yellow Zone) and Slope Disaster Special Hazard Zone (Red Zone), and conducts awareness activities for residents so that the residents understand the Slope Disaster Prevention Law. A poster showing the following contents is also used for awareness activity to the residents.

<Contents in the poster>

1. **Basic survey:**
   - Purpose of basic survey, brief definition of the Yellow Zone and the Red Zone
2. **Range of the Yellow Zone and the Red Zone:**
   - Definition of each disaster type
   - Explanation on range of the Yellow Zone and the Red Zone for each disaster type.
3. **Contents of regulation:**
   - Yellow Zone: Warning/evacuation system
   - Red Zone: Specific Land Development, restriction on building structure, and relocation
4. **Contact to the Local Government:**
   - Contact to the Local Government in order to receive the questions and opinions from residents.

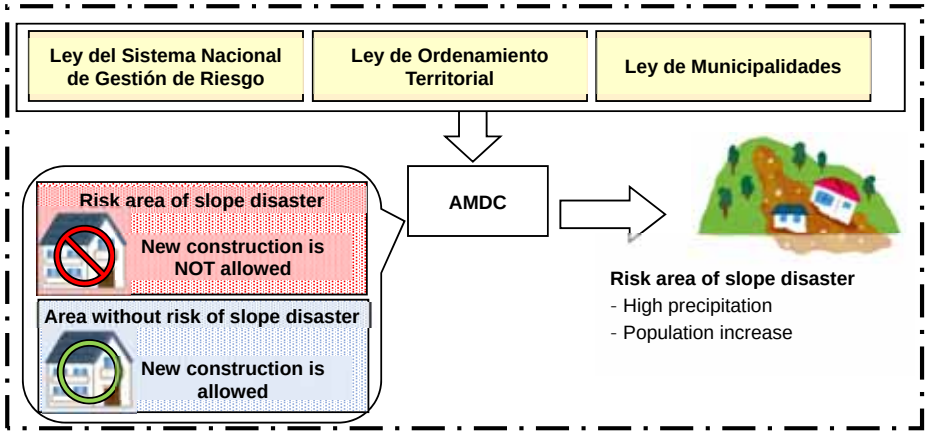
<Other awareness activity>

In order to raise the awareness of the residents in prevention of slope disasters, the following activities are conducted by the Local Government in Japan.

1. **Seminar for residents**
   - Seminar on slope disaster and Disaster Risk Reduction
   - Mechanism of Slope Failure/Rockfall and Landslide
2. **Art competition on slope disasters for students**
   - Encourage students to understand and to be interested in slope disaster

3. Land use regulation in Tegucigalpa

3.1 Actual situation in Tegucigalpa



<Situation in Central District>

- Slope disasters due to hurricanes or heavy rain during the rainy season
- Loss of life and property due to slope disasters
- Increase in population in slope area due to migration from other regions
- No efficient countermeasure works in zones where the population is increasing
- Difficulty in implementation of countermeasures works for all risk areas due to limitation of budget and personnel
- Demand for measures in soft component in addition to measures in hard component

<Laws related to Disaster Risk Reduction (DRR) in Honduras>

1. Ley del Sistema Nacional de Gestión de Riesgo:

- Establish a legal framework that the Central Government develops capabilities to prevent and mitigate disaster risks, and deals with disaster damage, restoration and reconstruction.

2. Ley de Municipalidades:

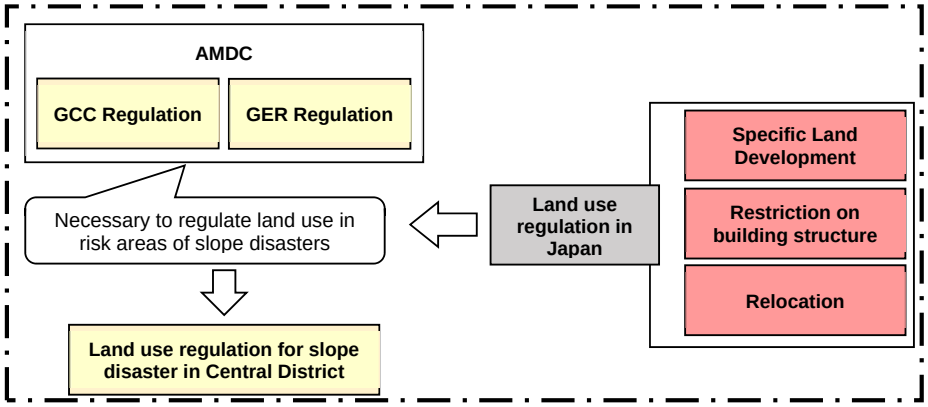
- Authorize the Local Government to prepare the urban development plan and land use regulation for land management.

3. Ley de Ordenamiento Territorial:

- Specify the land use plans prepared at the Central Government and the Local Government levels.

The current situation of the Central District as well as the laws related to DRR show that soft component such as land use regulations is especially required. The soft component is effective to prevent slope disasters in addition to hard component, which is difficult to implement at all risk areas because of lack of budget and personals. Additionally, laws related to DRR specify that the Local Government is authorized to take necessary measures for prevention works, by establishing a land use plan or regulation.

3.2 Existing regulations in AMDC



<Reglamento de la Zonificación, Obras y Uso del Suelo en el Distrito Centra (GCC Regulation)>

- Set standards for development activities and land use, and establish procedures and requirements for the activities
- Establish a regulation applied on land use related to new construction, extension and reconstruction, relocation, and demolition of buildings.
- Authorize Gerencia de Control de la Construcción (GCC) to survey, report and issue various documents related to development activities and land use

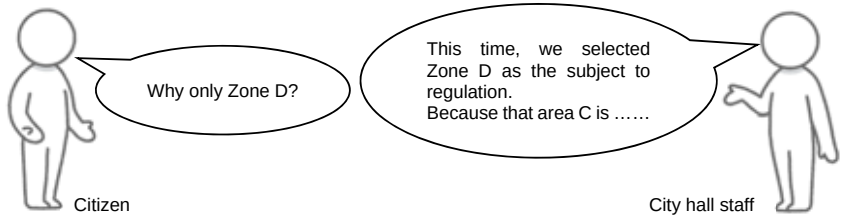
<Reglamento para la Reduccion de Resgo de Desastres en el Distrito Central (GER Regulation)>

- Establish regulations on Disaster Risk Reduction, adaptation to climate change, and land use planning
- Implement an assessment by Gerencia de Evaluación de Riesgos (GER) before construction or development activities in risk areas.
- Allow to conduct only following activities in each hazard area:
  - High hazard: Mitigation works or activities which AMDC permits
  - Middle hazard: Activities allowed in high hazard area, and construction works such as one-story house and retaining wall
  - Low hazard: All construction works for both residential and commercial purpose

AMDC has already established regulations related to land use or development activities in the Central District. However, these regulations only specify general matter of them and can not apply to specific cases of slope disasters. Due to this background, AMDC needs to establish a land use regulation for slope disasters that restrict new construction or other works in risk areas of slope disasters. Additionally, the background of establishing land use regulations in Japan is similar to that in Honduras, so the experience and laws in Japan are helpful when creating a land use regulation for slope disaster in Central District.

3.3 Selection of the special regime zones

Name of zone	Urgency	Access	Related regulation	Future plans	Supportive population	Past projects	DTM	Point
A	Middle	Good	Yes	Yes	Yes	No	Yes	8
B	High	Bad	Yes	No	No	Yes	Yes	7
C	High	Good	Yes	Yes	Yes	No	Yes	10
D	High	Good	Yes	Yes	Yes	Yes	Yes	11



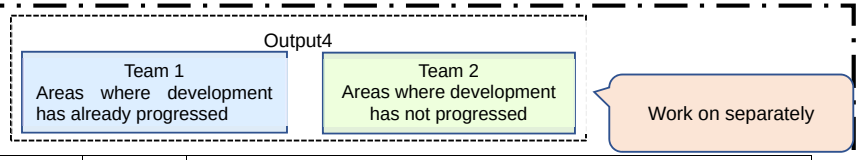
Why prioritization?:

- Central District: Many high risk areas of slope disaster exist, and countermeasures are demanded
- Prioritization for efficient implementation of countermeasures to areas in high demand
- Matrix used as decision-making tool to prioritize factors related to one topic, by giving points
- Explanation the reason why a specific zone has been chosen as a target among the high risk areas

<Content>:

1. **Urgency (High, Middle, Low): 3 points to "High", 2 to "Middle", and 0 to "Low".**
   - There is a risk of slope disaster existing, and countermeasures are demanded in the zone
2. **Access (Good, Normal, Bad): 3 points to "Good", 2 to "Normal" and 1 to "Bad"**
   - The AMDC staff can frequently visit the zone, from the perspective of distance and safety during survey, discussion with residents and monitoring
3. **Related regulations (Yes, No): 1 point to "Yes", 0 to "No"**
   - There are existing regulations in AMDC or national law related to land use in the community
4. **Future plans (Yes, No): 1 point to "Yes", 0 to "No"**
   - There are plans related to rapid population growth or was a rapid urbanization in the zone
5. **Supportive population (Yes, No): 1 point to "Yes", 0 to "No"**
   - There is CODEL which conducts activities on Disaster Risk Reduction in the zone
6. **Past projects (Yes, No): 1 point to "Yes", 0 to "No"**
   - There was a project by JICA or other donners (or useful information) existed in the zone
7. **DTM (Yes, No): 1 point to "Yes", 0 to "No"**
   - The zone is located in the range of Digital Terrain Model data which AMDC has

3.4 Scope of work for land use regulation of pilot special regime zones



Team1	Team2	Contents
Step 1	Step 1	Comparison of land use regulations in Japan and Honduras
Step 2	Step 2	Examination of regulation target
Step 3	Step 3	Examination of regulation details
Step 4	Step 4	Consideration of application procedure by local residents
Step5	Step5	Creation of explanation materials for approval of regulation by AMDC
Step6	Step6	Creation of the land use regulation map (draft)
Step7	Step7-1	Discussion with representatives from CODEL
-	Step7-2	Socialization with relevant ministries/agency (only for Team2)
Step8	Step8	Finalization of land use regulation (draft)

Members in Output4 were divided into 2 teams which work separately

- Team 1: Regulations for zones where development has already progressed
- Team 2: Regulations for zones where development has not progressed

Each team works 9 steps to make land use regulation in Central District

Step1. Comparison of land use regulations in Japan and in Honduras

- To examine the existed regulation of AMDC (GCC regulation, GER regulation) and the classification of hazards in zone

Step2. Examination of the target of regulation

- To determine the type of building or land use

Step3. Examination of regulation detail

- To determine the detailed content of regulation such as restriction on building structure, and license system for Specific Land Development etc.
- To examine the feasibility in Honduras with reference to Japanese land use regulations

Step4. Consideration of application procedures by local residents

- To examine the required application procedures for residents who conduct a Specific Land Development

Step5.Creation of explanation materials for approval of regulation by AMDC

- To understand the internal procedures of AMDC to approve regulations in AMDC
- To prepare a format and explanation materials to obtain approval at AMDC

Step6. Creation of the land use regulation map (draft)

- To create a land use regulation map based on the activities in Output 3

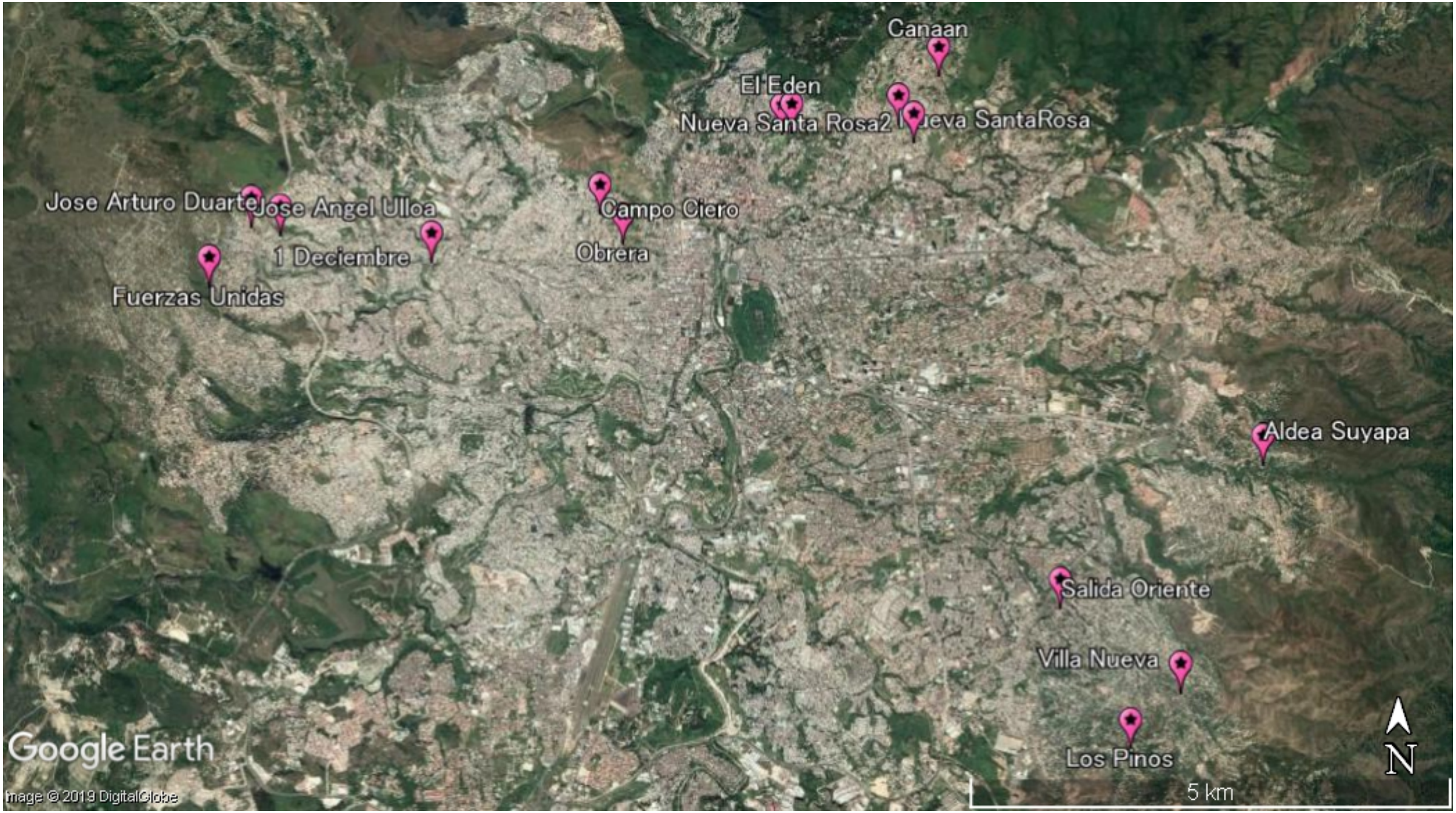
Step7-1. Discussion with representatives from CODEL, and Step7-2. Socialization with relevant ministries/agencies

- To obtain the necessary opinions to modify and improve the draft of land use regulation

Step8.Finalization of land use regulation (draft)

Appendix 3

6 Selected pilot sites


Canaan
El Eden
Nueva Santa Rosa2
Nueva SantaRosa
Jose Arturo Duarte
Jose Angel Ulloa
1 Deciembre
Fuerzas Unidas
Campo Ciero
Obrera
Aldea Suyapa
Salida Oriente
Villa Nueva
Los Pinos
Google Earth
Image © 2019 DigitalGlobe
N
5 km

別添資料7

Campo Cielo

Nueva Santa Rosa

Fuerzas Unidas

Villa Nueva

El Bambu

Jose Angle Ulloa – Jose Arturo Duarte

Appendix 4

Result on Landslide Monitoring

Result of Landslide Monitoring

1. Nueva Santa Rosa

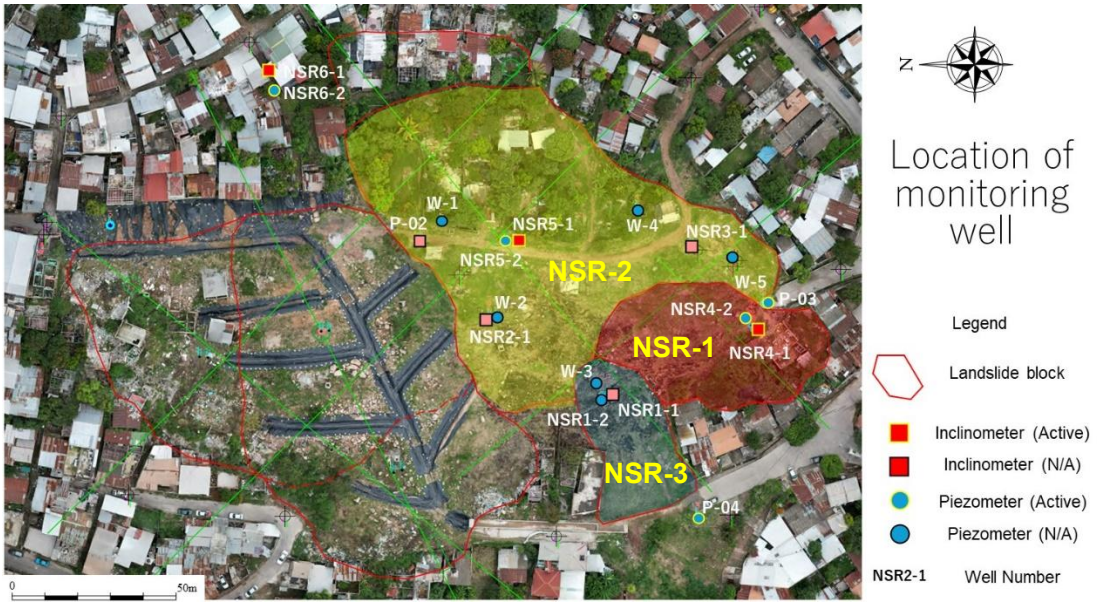


Figure1-1　Monitoring well in Nueva Santa Rosa

1.1 Surface movement

Figure 1-2　Monitoring point of surface measurement in Nueva Santa Rosa

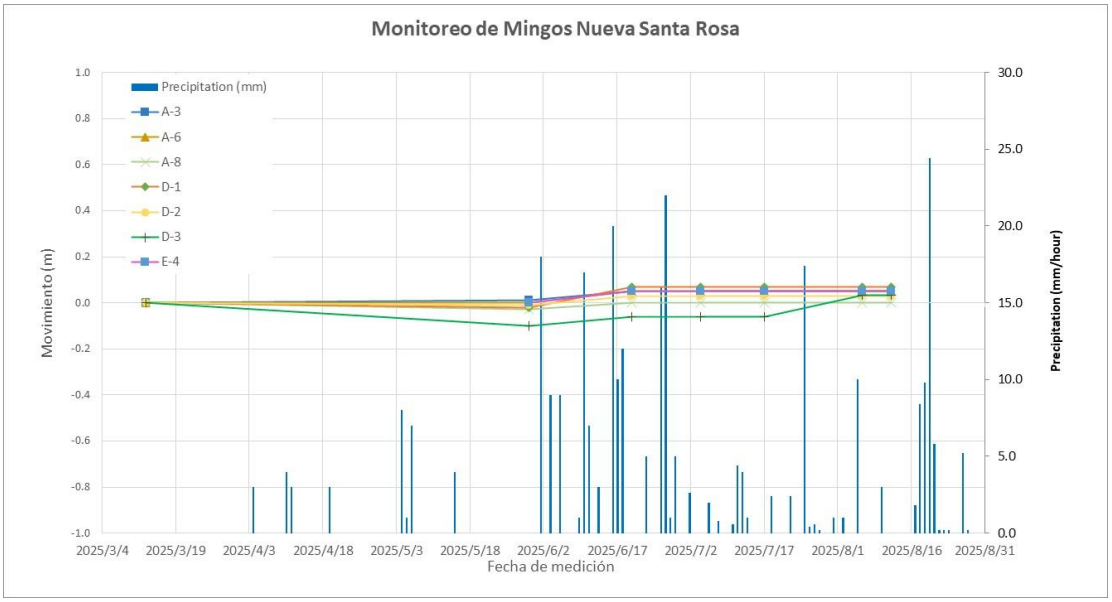


Figure 1-3 Result surface monitoring in Nueva Santa Rosa

1.2 Borehole Inclinometer

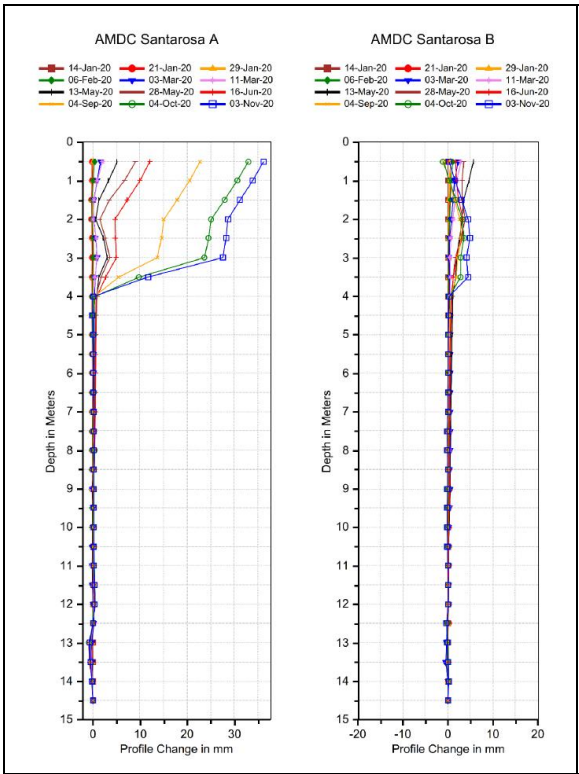


Figure 1-4 NSR1-1

（Not available in November 2020）

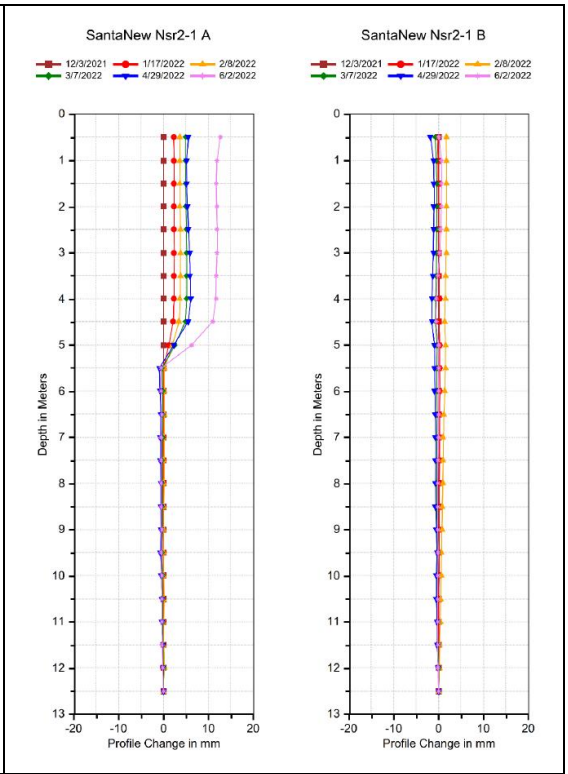


Figure 1-5 NSR2-1

（Not available in July 2022）

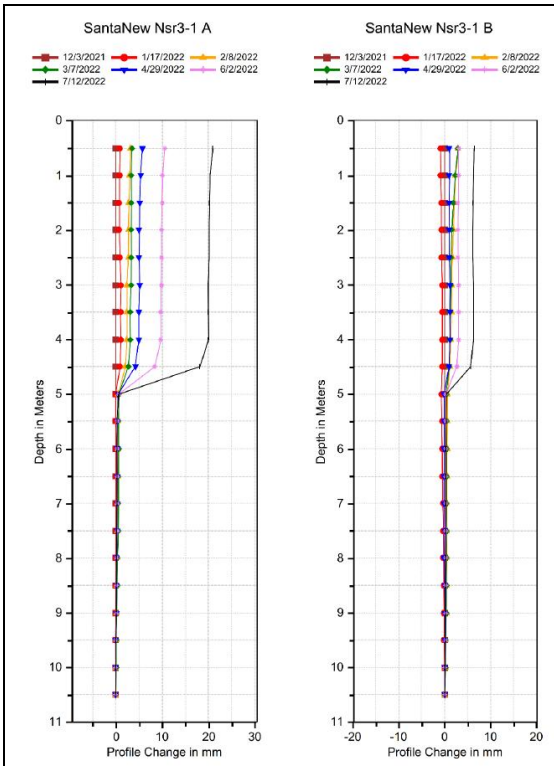


Figure 1-6 NSR3-1

（Not available in July 2022）

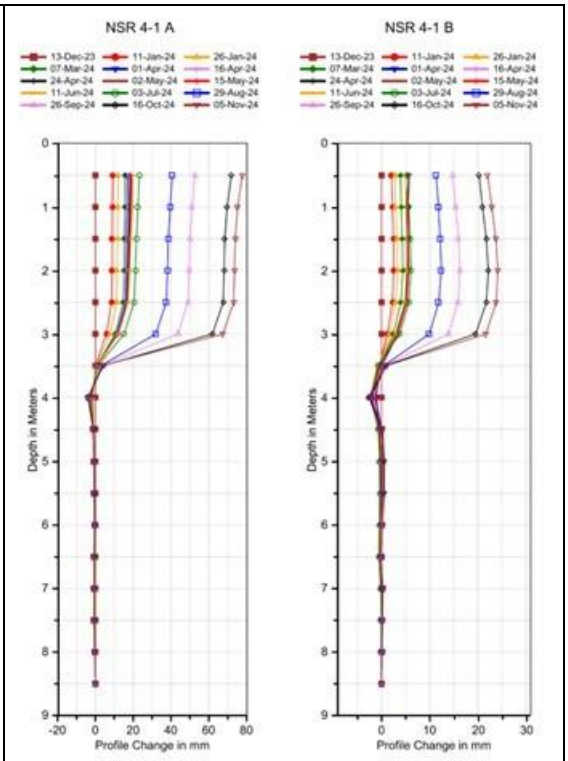


Figure 1-7 NSR4-1

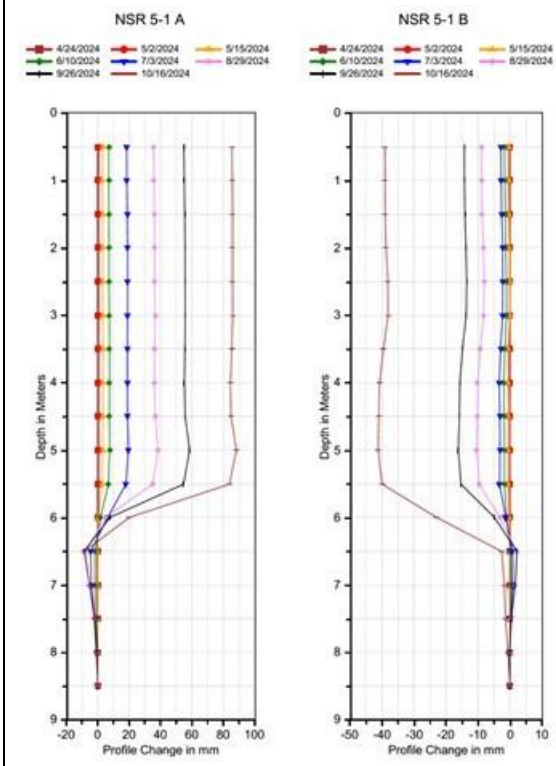


Figure 1-8 NSR5-1

（Not available in October 2024）

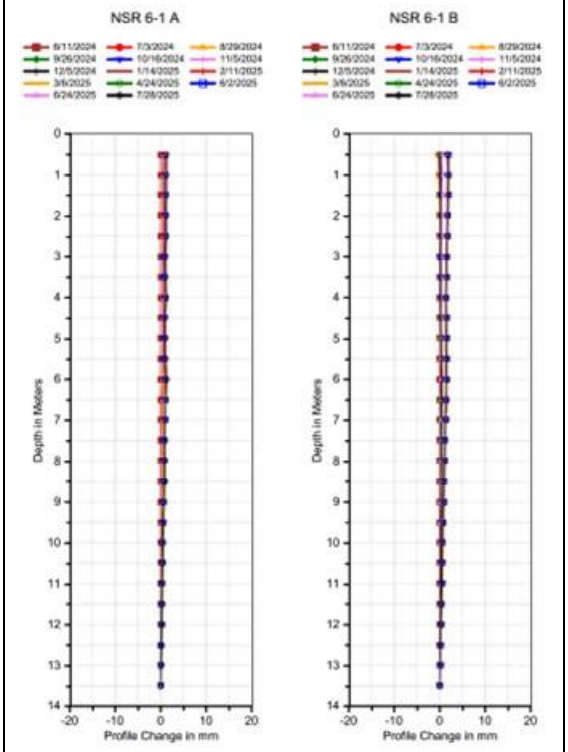


Figure 1-9 NSR6-1

1.3 Groundwater level

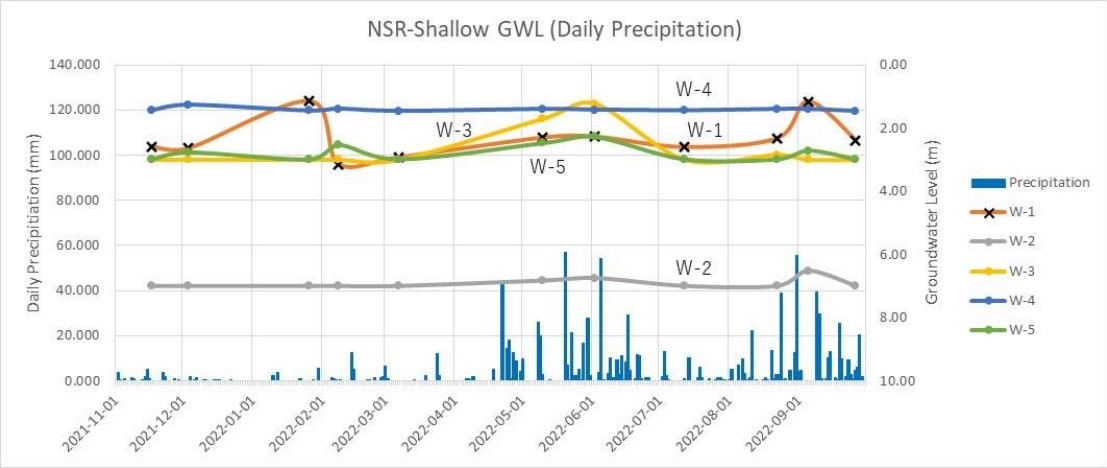


Figure 1-10 Shallow groundwater level monitoring

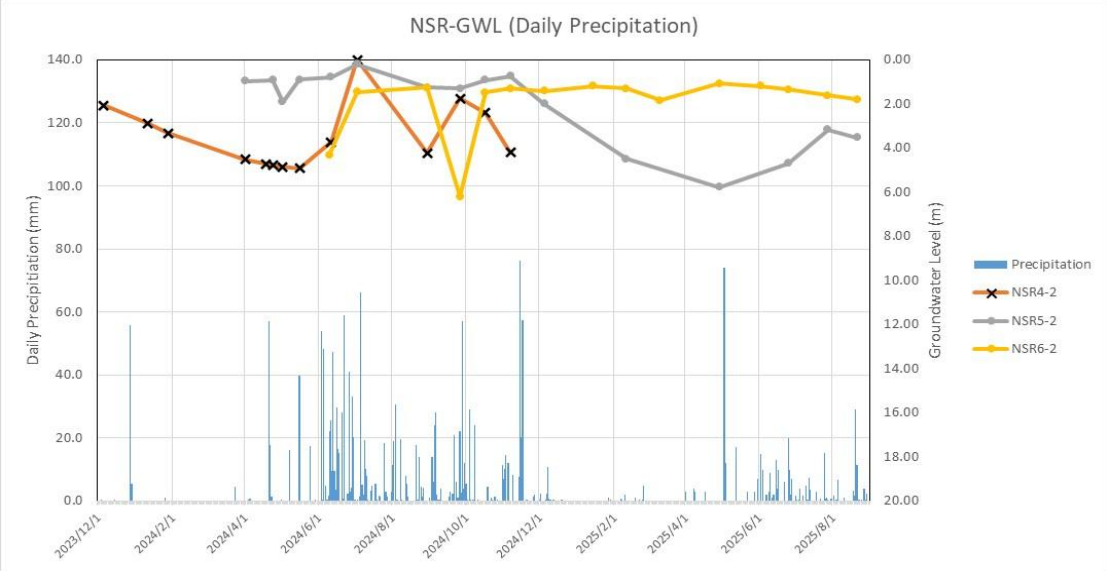


Figure 1-11 Groundwater level at NSR4-2, 5-2, and 6-2

1.4 Discussion

■ Landslide block NSR-1

It was observed that many cracks occurred in July 2023 and that the crack had progressed. Since monitoring wells for measuring landslide displacement were not installed in this block, a simple measurement point was established on July 19, 2023 to measure crack displacement on the ground surface (Figure 1-2). As a result, during the measurement on November 17, 2023, tensile displacement was observed near the upper slide cliff of the landslide block (A4 and A6), and compressive displacement was observed in the middle (A5) and end (A7 and A9) of the landslide block. There is also displacement in the tensile direction of less than 5 mm at the landslide block midsection A8. No displacement of the level measured with a tape measure has been detected since February 2024.

In inclinometer monitoring well NSR4-1, which was installed in the landslide block in December 2023, landslide displacement was observed at a depth of around GL-3.5 m during measurements in January 2024. The displacement at that time was 8.5 mm at a depth of GL-2.5 m. Subsequently, the displacement rate was about 1 mm/month in measurements from March through May 2024. Then, from April to June 2024, the movement calmed down with monthly displacement of about +0.2 mm. after mid-June 2024, the displacement rate slightly accelerated to around +10 mm/month, and the displacement rate measured in October 2024 further accelerated to +18 mm/month. in November 2024, the displacement rate decreased at 5.5 mm/month.

The groundwater level was observed at a depth of GL-2.05 m in the NSR4-2 borehole installed in December 2023, and then slowly decreased to GL-4.9 m on May 16, 2024. The water level rose +0.8 m from the previous month when measured in early June 2024 was almost at the surface (GL-0.00 m) by the beginning of July 2024. On September 26, groundwater level was confirmed at GL-1.74m, close to the previous high water level. 58mm of daily rainfall was confirmed on September 28, but groundwater level did not rise and dropped to GL-4.19m in November 2024. No significant rainfall has been observed since then.

Based on the above, it can be concluded that landslide block, NSR-1, started to be active in July 2023 and continued to be active until January 2024, because of the significant tensile displacement at the top of the block and the compressive displacement at the end of the block, the landslide displacement at the depth of GL-3.5m and below, and the continuity of cracks and steps (displacement) at the ground surface. After that, the landslide block stabilized to some extent, and combined with the fact that the groundwater level was distributed at depths below the slip surface, the activity shifted to a stable state, although there was rainfall of more than 50 mm/day in April 2024. Subsequently, groundwater levels rose due to heavy rainfall in June, and the landslide is thought to have become active again. However, since the landslide had calmed down once, it is assumed that the changes of rainfall and groundwater level will be the direct cause of landslide activity in the future.

According to the result of monitoring of inclinometer (see Figure 1-12), the rate of displacement increased slightly from June 2024, and further increased from September to October 2024. Groundwater displacement during this period shows that the groundwater level has been below the slip surface (GL-3.5m) since June 2024, although a drop in the groundwater level was observed at the end of August 2024. The groundwater level during that period (GL-4.19m) was below the slip surface (GL-3.5m). This suggests that groundwater is contributing to the activation of the landslide block NSR-1. At NSR5-2 borehole, the groundwater level showed a declining trend from December 2024, with the groundwater level confirmed at a depth of 6m until May 2025. However, significant rainfall occurred in June 2025, and an increase to a depth of 3.1m was confirmed in July 2025. In August 2025, a groundwater level decrease of approximately 0.5m was observed. Meanwhile, the water level in NSR6-2 borehole has been gradually declining since the 73mm hourly rainfall on May 3, 2025.

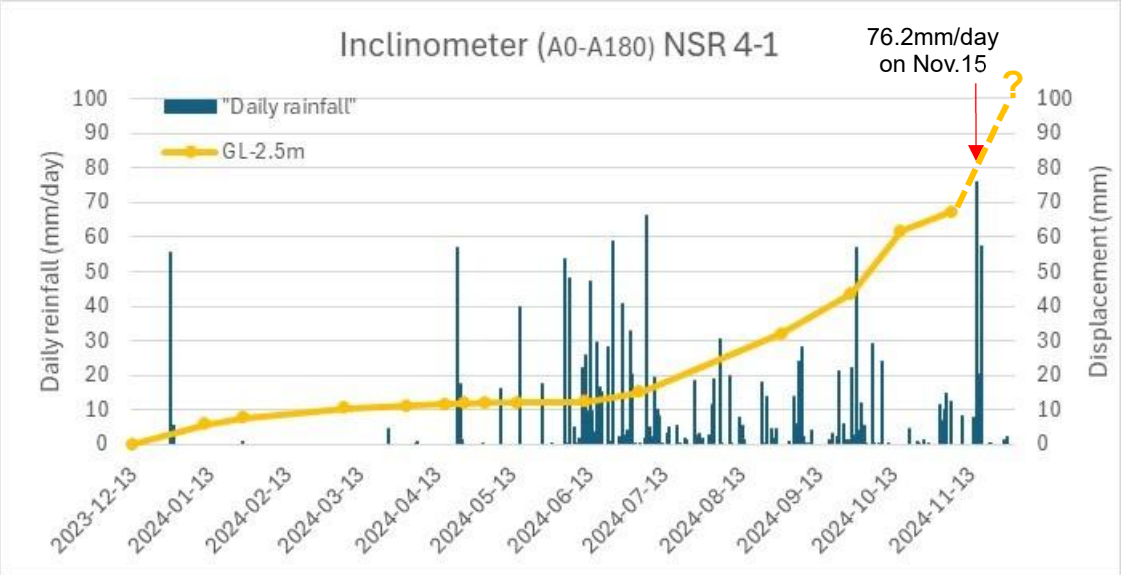


Figure 1-12　Displacement of the depth of 2.5m in NSR4-1

■ Landside block NSR-2

As in block NSR-1, the existing monitoring wells were damaged by the landslide activity and could not be measured, so a simple observation point was established and regular observations were made (Figure 1-2). According to the results of the simple measurement, from the start of the measurement until April 2024, no clear displacement that could be detected with the accuracy of a tape measure was observed near the cliffs above the landslide block (A1, A3) and in the middle of the landslide (A2).

In borehole NSR5-1, which was installed in April 2024, landslide displacement was observed at a depth of GL-6m two weeks after date of installation, and the amount of displacement was 0.8mm at GL-5.0m. The amount of displacement was 0.8mm at GL-5.0m. The cumulative displacement was confirmed after that, and the amount of displacement continued to increase at an accelerated rate: +4.4mm in June, +12mm in July, +18.8mm in August 2024, +20.2mm in September 2024, and +29.9mm in October 2024. This indicates that the displacement had progressed further. This is thought to be due to further displacement. Since its installation in March 2025, there was virtually no movement until the end of May 2025. However, displacements of 5 cm at A3 and 7 cm at D1 were confirmed between May and June 2025. After June 2025, no displacement was detected at D1 even in measurements taken in August 2025. At A3, a 2 mm extension-direction displacement was measured compared to July 2025.

In monitoring well of groundwater level NSR4-2 installed in April 2024, groundwater level was observed at a shallow depth of GL-0.95m, and has remained around GL-0.9m since then. The groundwater level dropped temporarily by about 1 m on May 2, 2024. The water level returned to its original level two weeks later. 1.3m and remained almost the same as last month, but on October 18 and November 7, the groundwater level was GL-0.98m and GL-0.74m, respectively, indicating that the groundwater level is continuously rising.

From the result above, it can be inferred that the groundwater level in landslide block NSR-2 is extremely high in the rainy season and that landslide activity is also increasing. In addition, it can be considered that NSR-2 and NSR-1 are different landslide blocks because the displacement trend at the ground surface, the displacement rate measured by the inclinometer, and the depth of the groundwater table surface are different from those of NSR-1. Based on the measurement results of the inclinometer, the landslide activity level was continuously accelerated (see Figure 1-13), and in November 2024, the casing pipe was deformed by the landslide to the extent that the inclinometer could not be inserted. Since the groundwater level is also located near the surface and above the slip surface, it can be inferred that the landslide is still active. From May to June 2025, a 7 cm displacement was observed at D-1 and a 5 cm displacement at A-3. Although a 2 mm displacement was noted at A-3 after June 2025, no significant overall movement has been confirmed. While no complaints have been received from residents of houses adjacent to the left wall of this block, there remains a significant possibility that future rainfall could trigger landslide activity affecting these houses. JET advised AMDC and CODEM to continue conducting on-site inspections and maintaining communication with residents.

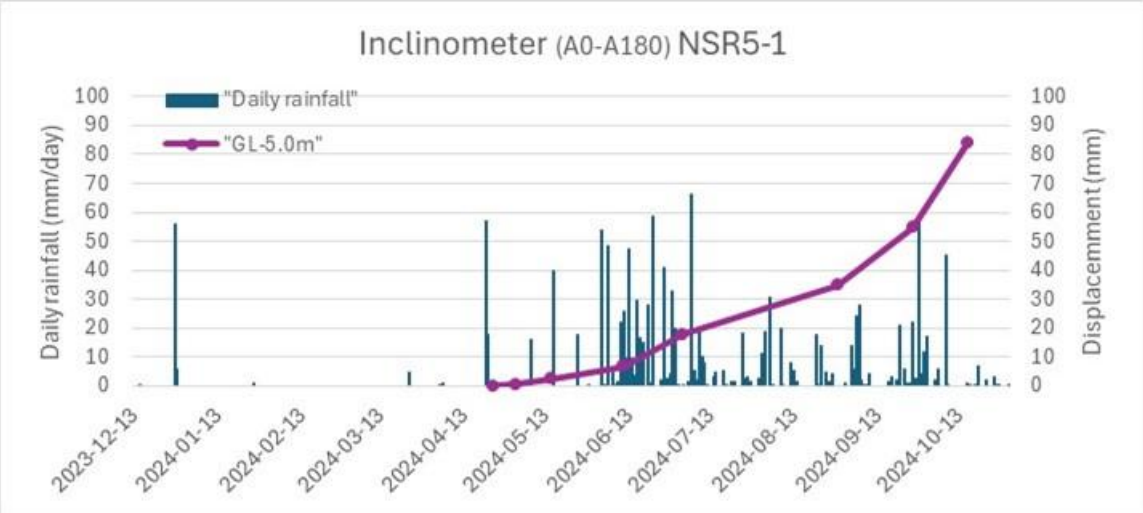


Figure 1-13 Displacement of the depth of 5.0m in NSR5-1

■ Landslide block NSR-3

The borehole NSR1-1 and NSR1-2 located within this block were destroyed by past landslide activity and are currently unmeasurable. In addition, ground surface displacement measurements were not taken by CODEM, so although no significant displacement was observed in the field, the presence of quantitative displacement cannot be examined. At D-3, which is measuring the NSR-3 block at the end of the landslide block, displacement in the compression direction was observed in May, followed by displacement in the extension direction in June. This can be interpreted as the distance at D-3 shortening in May due to the downward movement of the block behind it, and then lengthening again as the NSR-3 block moved.

At present, no significant deformation of surrounding houses or structures, nor continuity of landslide displacement, has been observed. As the rainy season is about to begin in earnest, it was confirmed that regular monitoring at this observation point will continue, paying close attention to the progression of changes, displacement rates, and the presence or absence of deformation

■ Area out of landslide blocks

A borehole inclinometer NSR6-1 was installed behind the landslide block in the NSR area to monitor the area out of the landslide blocks. Measurements began on June 13,2024, nd since then, monthly displacement has been about 0.2 mm, but cumulative displacement of less than 1 mm has been confirmed until September 2024. Although the location of the slip surface is not clear, it is considered to be at GL-10.0m based on the amount of displacement at each depth. Figure 1-14 summarizes the displacement at the depth of 7.0m, where the displacement is stable. The groundwater level was also measured, and although it dropped to GL-6.2m in September, the groundwater level is generally around GL-1.2m.

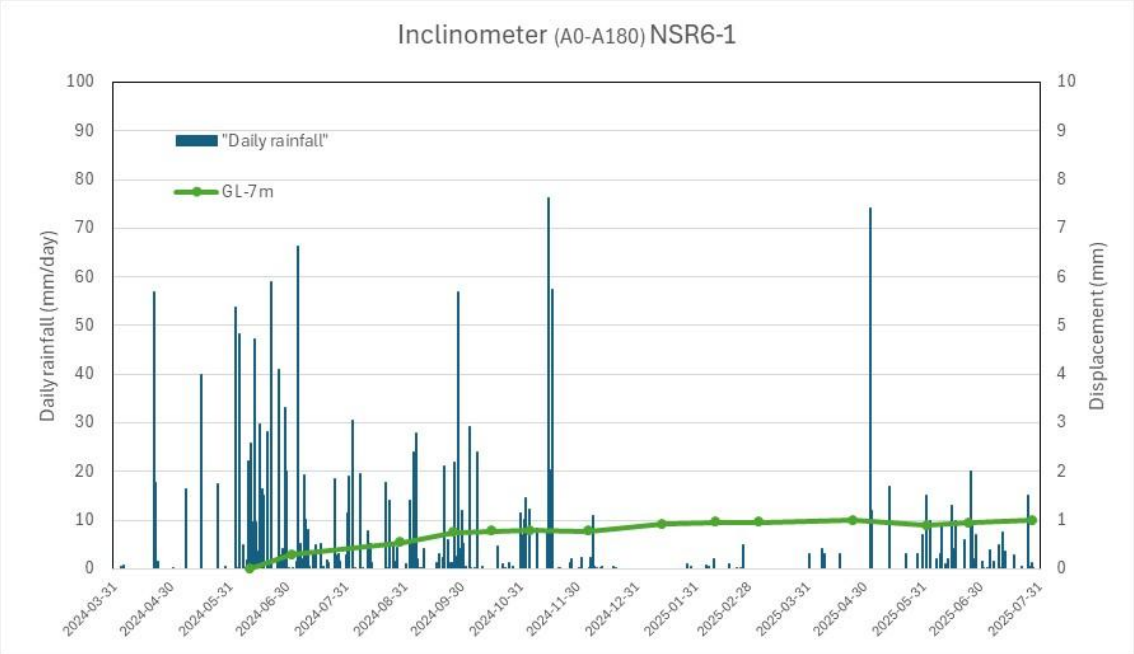


Figure 1-14 Displacement of the depth of 7.0m in NSR6-1

■ Fluctuation of Groundwater Level in Nueva Santa Rosa

In shallow groundwater level monitoring wells W-1 to W-5 in the NSR area, groundwater levels in the boreholes were observed at GL-2 to -3 m, and water level fluctuations were observed in response to the amount of rainfall, especially in boreholes W-1 and W-3 (see Figure 1-10). The water table fluctuates in response to the amount of rainfall (W-1 and W-3) and in response to the amount of rainfall (W-2, W-4, and W-5), but this may be due to the ease of groundwater stream way (differences in soil permeability and porosity) and proximity to major underground water courses (e.g., the water table

tends to rise near water courses due to increased water volume caused by rainfall). It can be considered that this trend may be due to the local distribution of different properties in the landslide soil masses that have been subjected to past fluctuations, rather than sedimentary or igneous rock. All of these shallow groundwater monitoring wells were ruptured and not available by the landslide disaster in September 2022.

Subsequently, new groundwater level monitoring wells (NSR4-1, NSR5-2, and NSR6-2) were installed in 2023, and the water level in the boreholes has been displaced between -2 m and -4 m GL (see Figure 1-11). The displacement trend of the water level in these boreholes is similar to that of the shallow groundwater level monitoring wells mentioned above, and can be said to correspond to the amount of rainfall. The reason for the difference is the same as that of the shallow groundwater level monitoring wells.

2. La Guillen

Figure 2-1 Location of monitoring well in La Guillen

2.1 Surface movement

Figure 2-2 Monitoring point of surface measurement in La Guillen

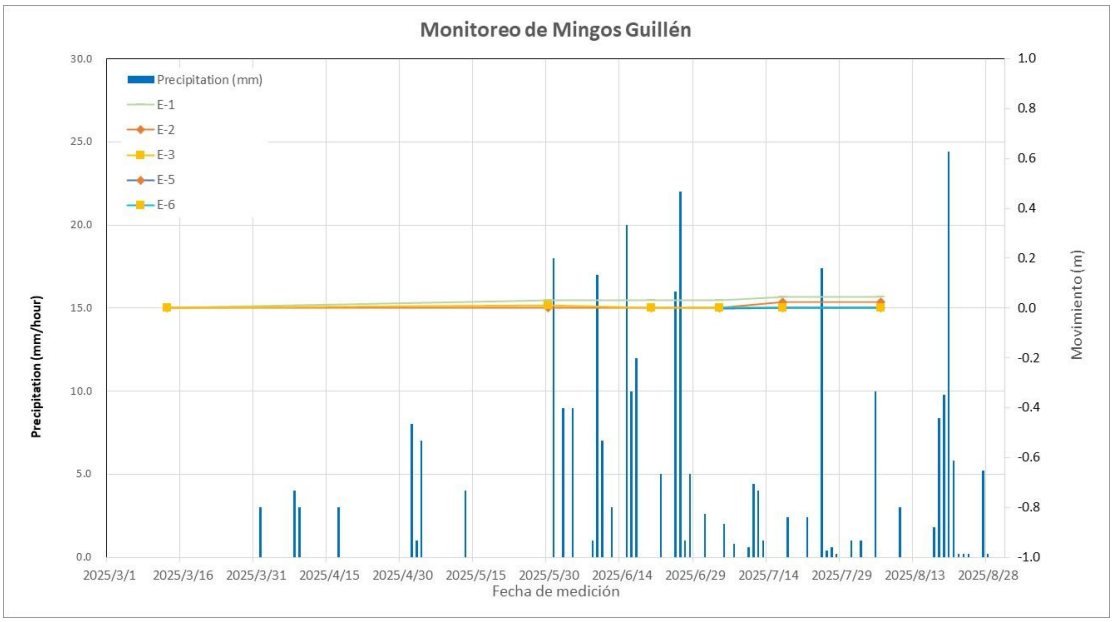


Figure 2-3 Result of Surface Monitoring in La Guillen

2.2 Borehole Inclinometer

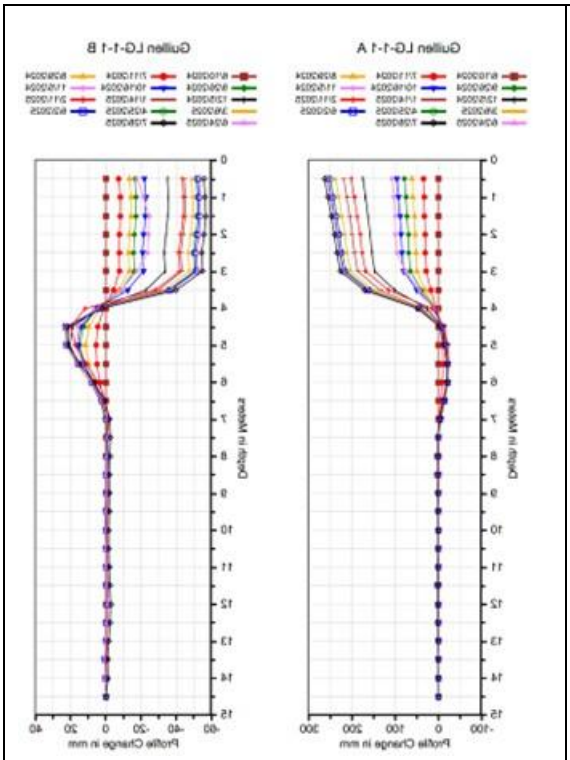


Figure 2-4 LG1-1

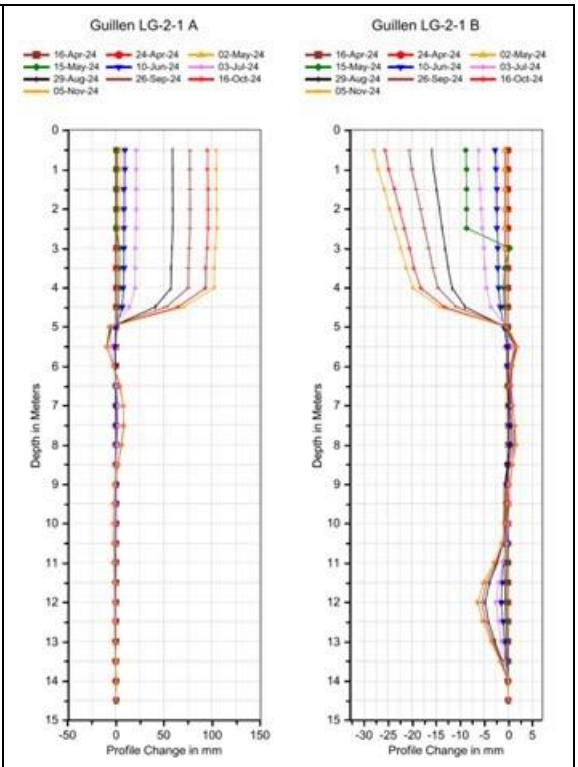


Figure 2-5 LG2-1

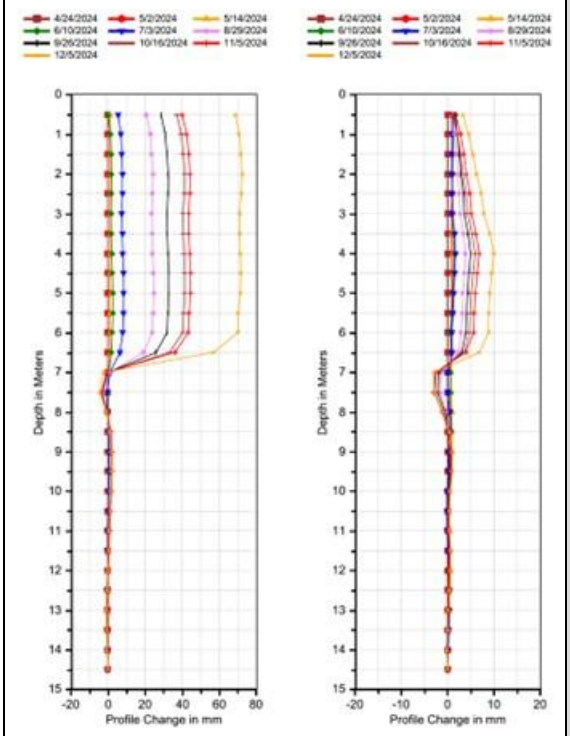


Figure 2-6 LG3-1

2.3 Groundwater Table

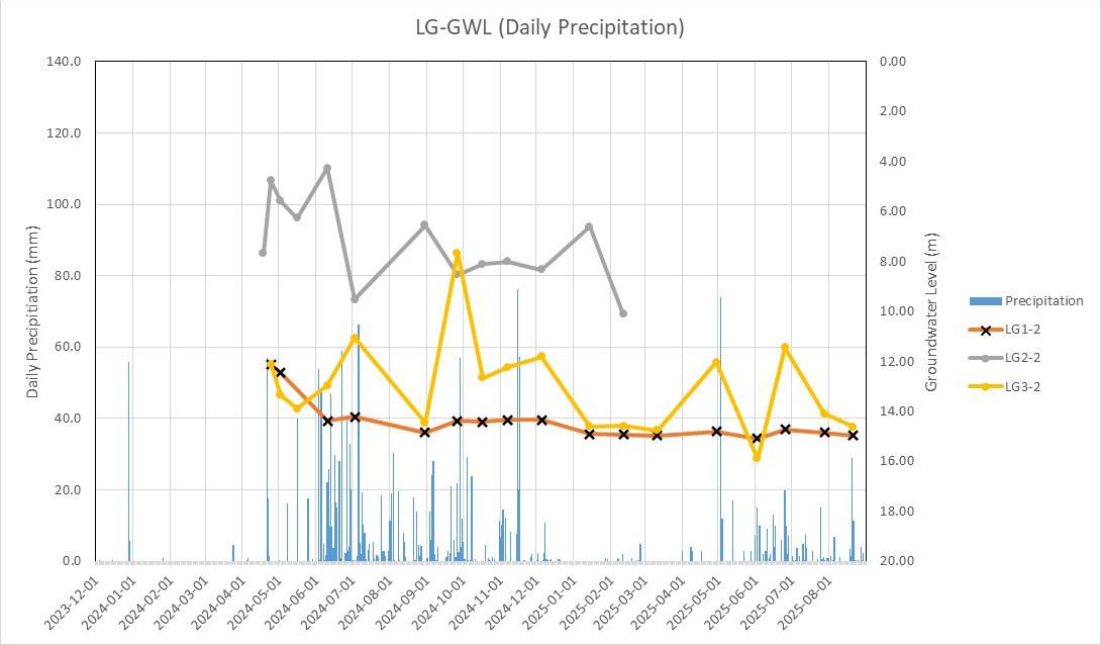


Figure 2-7　Groundwater level at LG1-2, LG2-2, and LG3-2

2.4 Discussion

■ Landslide block LG-1

The landslide occurred in La Guillen in October 2022. According to the results of the field survey and drone photo analysis, the landslide moved in a southwesterly direction immediately after the onset, and then changed its direction to west-southwest. Since this was a new landslide and there were no existing monitoring wells, six simple observation points to measure cracks on the ground surface were established in February 2024 to understand the movement until monitoring wells were installed (Figure 2-2). Of these, 30 mm of compressive displacement was observed at the upper part of the landslide block (B1), and 10 mm of tensile displacement was observed at the lower part of the block (B5). No significant displacement was observed at the other cliffs (B2 and B3) and from the mid to lower part of the block (B4 and B6). Generally, tensile displacement is observed at the cliffs and compressive displacement is observed at the ends of the blocks. However, since this was immediately after the landslide, it is possible that the unstable overburden on the ground surface moved temporarily. Measurements taken on June 24 confirmed a 3 cm displacement at E-1, installed at the top of the landslide cliff, while no displacement was detected at E-2, installed on the right side wall of the block. In the August measurements, no displacement was confirmed at either E-1 or E-2.

In borehole LG3-1, which was installed on April 24, 2024, there was no clear displacement on May 2, 2024 but minor displacement was observed on May 14 at a depth of GL-7.0m. The displacement

was at a depth of GL-6.0 m. The displacement rate was about +1 mm/month during May and June 2024, but the displacement rate accelerated to +7 to +8 mm/month from the time of measurement in July to October 2024, but the displacement rate decreased significantly to +3 mm/month during the measurement in November 2024.

The water level was observed at a depth of GL-12.12 m in groundwater level monitoring well LG3-2, which was installed on April 24, 2024, and the water level further decreased thereafter, reaching GL-13.89 m on May 16, 2024. In June 2024, the water level in the borehole showed an upward trend due to the significant rainfall, although the water level in the borehole decreased in the following month, On September 26, 2024, the highest water level was observed at GL-7.65 m, which was the highest level since the start of measurements, but on October 18, the level dropped again to GL-12.65 m, and in November 2024, the level was confirmed to be about the same at GL-12.24 m.

According to the result of monitoring of the borehole inclinometer, landslide activity was confirmed in June 2024, when a heavy rainfall started. This is presumably due to the lack of significant rainfall from October to November 2024. The observed water levels in the boreholes were not significantly displaced compared to October 2024, and all were found to be deeper than the landslide surface (GL-7.5m). This suggests that groundwater level is not the cause of this landslide activity, or that there is a shallow groundwater level that occurs during rainfall, which is not captured by the regularly measured groundwater level observations. It should be noted that there is a certain degree of correlation between the fluctuation of the groundwater level in borehole LG3-2 and the amount of rainfall. Block LG-1 shows relatively small displacement among the landslide blocks in the NSR and LG areas, but its displacement rate is increasing. Consequently, significant rainfall could potentially accelerate its activity. AMDC regularly conducts on-site inspections and collects information from residents. No clear surface deformation has been observed in any of the landslide areas, and no damage reports have been received from residents of houses adjacent to the landslide blocks. Currently, displacement monitoring for this block relies solely on simplify monitoring points installed at the ground surface. These indicate a 3 cm displacement occurred between May and June 2025, with no displacement recorded in July and August 2025. Although it is currently the rainy season, this year's low rainfall is believed to be contributing to the reduced landslide activity. During this month's field survey, it was confirmed that a drainage pipe near the head of the landslide block was damaged, allowing household wastewater to flow into the landslide block. The relevant department at AMDC was immediately contacted and requested to repair it urgently. This reaffirmed the importance of AMDC's continuous on-site monitoring, which allows for the prompt identification of phenomena affecting landslide stability and enables rapid response to issues. Although countermeasure construction will commence soon, the rainy season is now in full swing. It was confirmed that it is important to reconfirm with residents the procedures for emergency evacuation and how to respond if any

changes are detected.

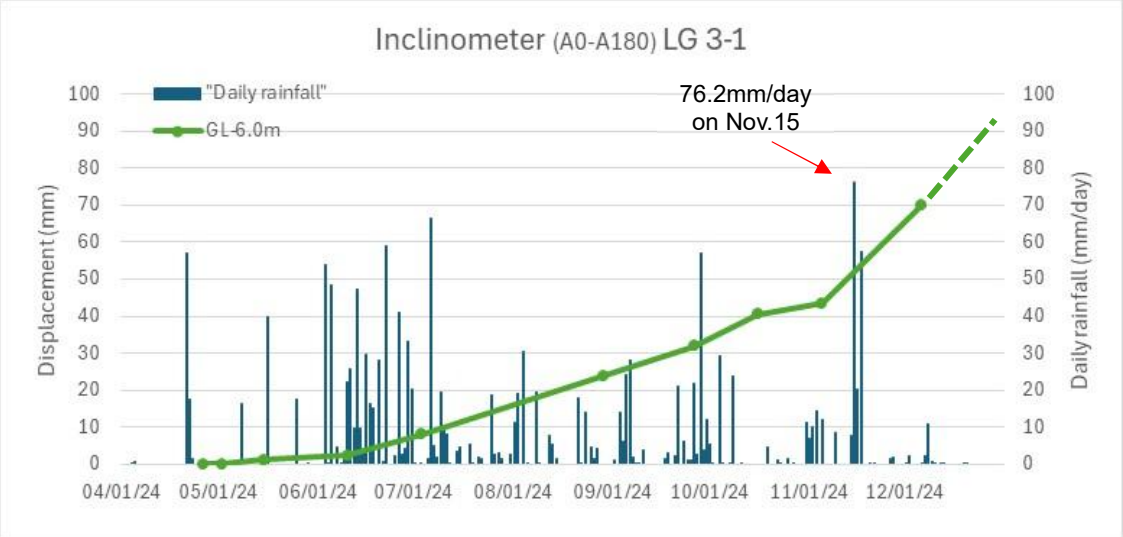


Figure 2-8 Displacement of the depth of 6.0m in LG3-1

■ Landslide block LG-2

The La Guillen landslide occurred in October 2022. Based on the results of the field reconnaissance and drone photo analysis, this landslide block was separated from landslide block LG-1 due to the different displacement directions and the continuity of the ground surface cracks. Since there were no existing monitoring wells, four simple observation points (C1-C4) were set up in February 2024 mainly near the block boundary to measure the ground surface cracks (Figure 2-2), but no significant displacement was observed at any of the observation points with the accuracy of tape measure measurements. At E-3, installed near the end of this block in May 2025, no significant activity has been observed since its installation.

Borehole LG2-1, a monitoring well for inclinometer, was installed within landslide block LG-2 in April 2024. landslide displacement was observed at a depth of GL-5.0 m at the LG2-1, and the displacement on May 15, 2024, one month after installation, was 3.7 mm at a depth of GL-4.0 m. Since June 2024, the monthly displacement rate of almost the same as the one in August 2024. The displacement rate increased until August 2024, and the displacement rate in August was +37.4mm compared to the July 2024; the displacement rate in September 2024 was +17.9mm compared to the October 2024, the displacement rate in October was +18.3mm compared to the previous month, and the displacement rate in November 2024 was +9mm compared to the previous month, showing an increasing trend.

Groundwater level observation well LG2-2 was installed within landslide block LG-2 in April 2024. The initial water level in the well was GL-7.67 m. After more than 50 mm of daily rainfall on April 21, 2024, the groundwater level temporarily increased by about 1 m and then slowly decreased. In August 2024, the groundwater level rose again and was confirmed at GL-6.54 m, although it did not

reach the slip surface; in September 2024, the groundwater level declined and was GL-8.53 m, but on October 18, 2024, the water level rose slightly to GL-8.1 m, and in November 2024, the water level was almost the same (GL-8.0 m).

According to the result of monitoring of the borehole inclinometer, a landslide with a slip surface depth of GL-5.0 m was active, and the displacement rate had been 12-18 mm/month since June 2024, but accelerated to about 20 mm/month in October 2024. In November 2024, the displacement rate decreased significantly to about 9 mm/month (see Figure 2-9). No significant rainfall was recorded during this period. Although it is difficult to examine the relationship between the timing of displacement and rainfall because the borehole tiltmeter is not a real-time measurement, at least there is no clear relationship between the water level fluctuation at the LG2-2 and the displacement trend of the landslide. However, monitoring results to date clearly indicate that rainfall significantly influences landslide activity. As substantial rainfall has been observed since June 2025, it is crucial that the AMDC continue conducting regular on-site inspections even more frequently than before. JET confirmed with the AMDC that preparations must be made to notify residents and facilitate evacuation should any progression of abnormal conditions be detected. As the rainy season intensifies, JET confirmed the importance of reconfirming emergency evacuation procedures and discussing responses with residents should any changes be detected.

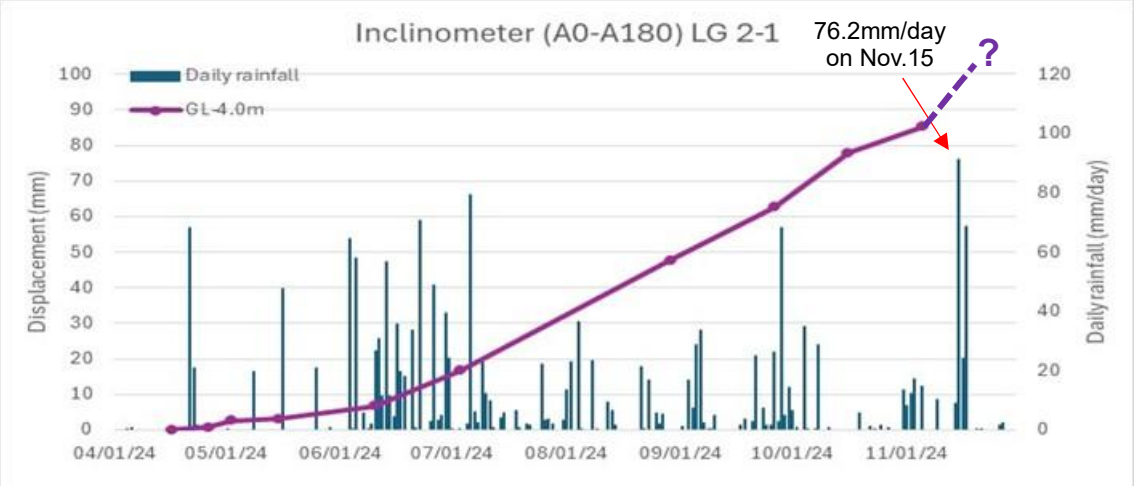


Figure 2-9 Displacement of the depth of 4.0m in LG2-1

■ Landslide block LG-3

Initially, LG-3 was not considered to be a landslide, but rather an area where sediments moved by the activity of landslide block LG-2 were deposited. However, since displacement that could be considered to be landslide-related was confirmed in borehole LG1-1, which was installed within this block, this area was also recognized as a landslide block and is now being measured.

Although the quality of the data from monitoring well LG1-1 is not very good, it is inferred from the observation results that there is a landslide surface at a depth of GL-4m. The cumulative

displacement at 3m depth shows that the displacement in July 2024 was as large as +28.1mm compared to previous month, then slowed down to about 12mm/month, but after September 2024, the displacement rate was about +15mm/month. After October 2024, it slowed down again and is 8mm/month. Although the displacement rate in July 2025 had decreased to approximately 6 mm/month, it was confirmed during August measurements that the borehole inclinometer could not be inserted into the observation casing. Consequently, all borehole inclinometer monitoring wells installed within the landslide block became not available.

The water level in borehole LG1-2 was observed at a depth of GL-12.12 m. Approximately 10 days after installation, the groundwater level dropped slightly and was confirmed at GL-12.46 m. In June 2024, the water level dropped further to GL-14.38 m, and has remained around GL-14.5 m since, reaching GL-14.42 m in October 2024 and No significant change was observed in the water level, which was GL-14.34m in October 2024 and GL-14.42m in November 2024. During this period, although there was an increase or decrease in the amount of rainfall, no relationship with the fluctuation of the groundwater level was observed.

According to the result of monitoring of the borehole inclinometer, a large monthly displacement of about 28 mm/month was observed in the initial measurement in July 2024, but the displacement rate slightly decreased to about 12 mm/month in the following month (see Figure 2-10). The displacement rate gradually increased and accelerated to about 15 mm/month at the time of measurement in October 2024, but slowed down slightly to about 8 mm/month at the time of measurement in November 2024. The water level in the borehole shows almost the same level regardless of the amount of rainfall. Therefore, the water level in borehole LG1-2 does not show as high a correlation as that of the amount of rainfall. The above situation suggests that the rise in the groundwater level is not the direct cause of the landslide activity. Because the landslide block LG-2 may have pushed the LG-3, the block LG-3 may be into displacement. Monitoring using the borehole inclinometer in July 2025 confirmed reduced activity in the affected block. However, measurements became impossible by the time of the measurement in August. This indicates that landslide activity has not ceased. Therefore, AMDC confirmed the importance of continuously monitoring the site and preparing to notify residents and facilitate evacuation if any progression of deformation is detected. As the rainy season intensifies, it was confirmed that it is important to reconfirm emergency evacuation procedures and responses to detected changes with residents.

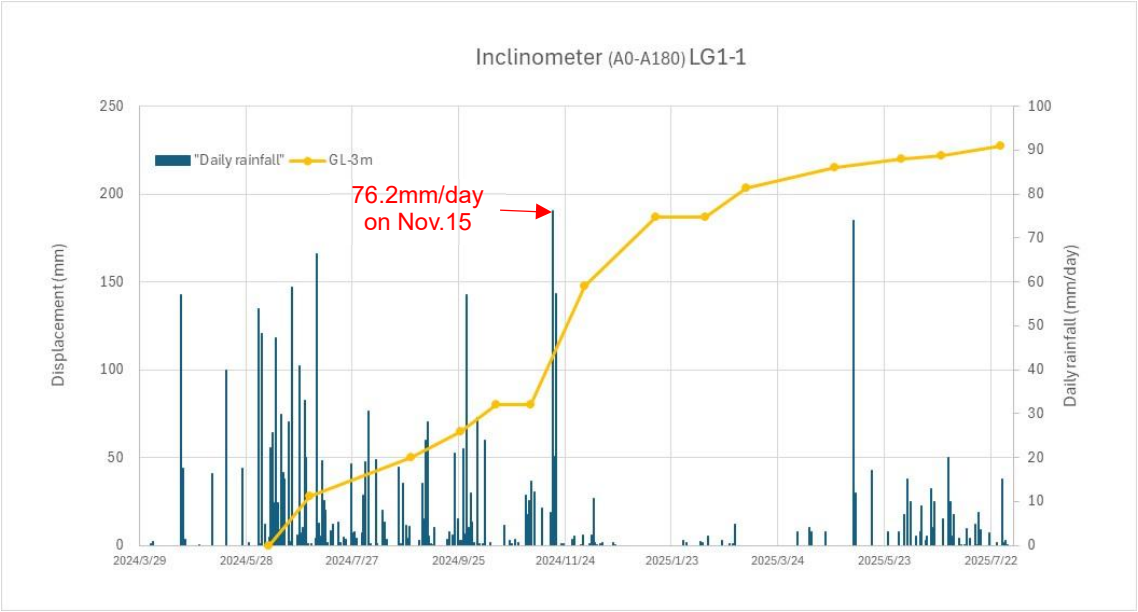


Figure 2-10 Displacement of the depth of 2.5m in LG1-1

3. Campo Cielo

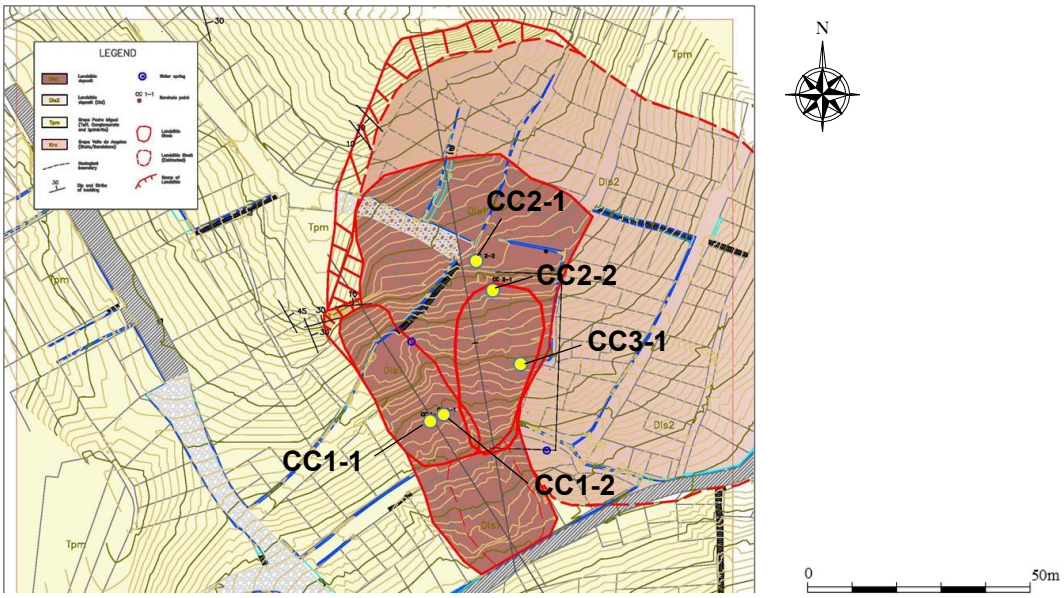


Figure 3-1 Location of Monitoring Well in Campo Cielo

3.1 Borehole Inclinometer

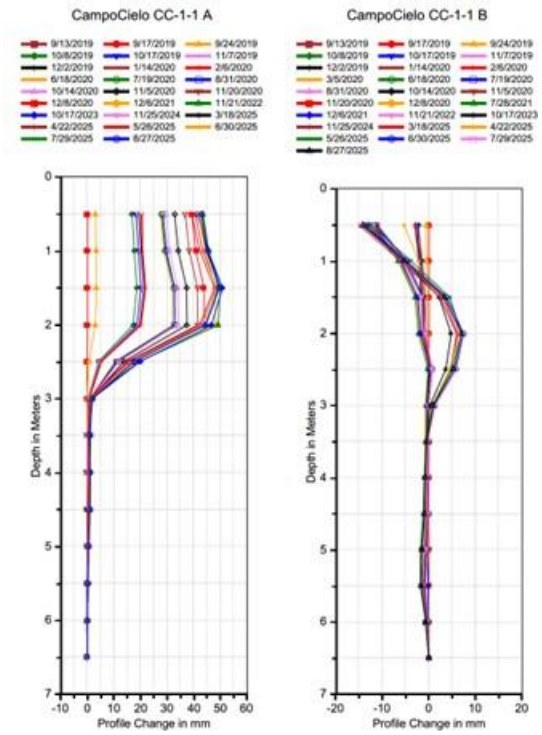


Figure 3-2 CC 1-1

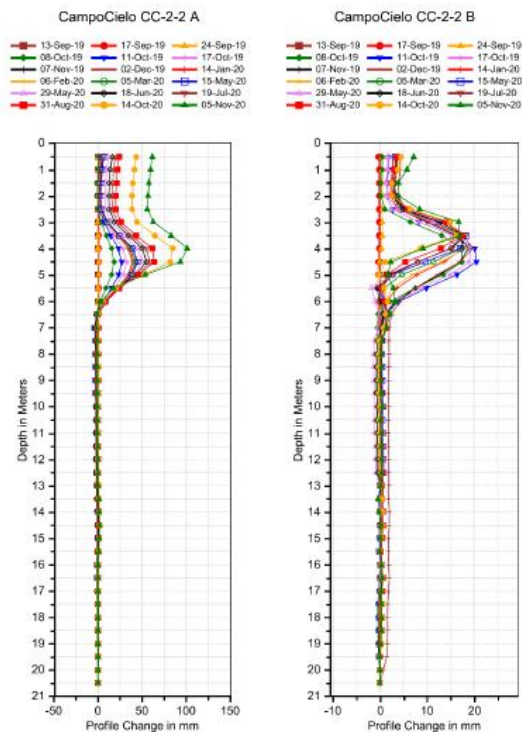


Figure 3-3 CC 2-1

（Not available in November 2020）

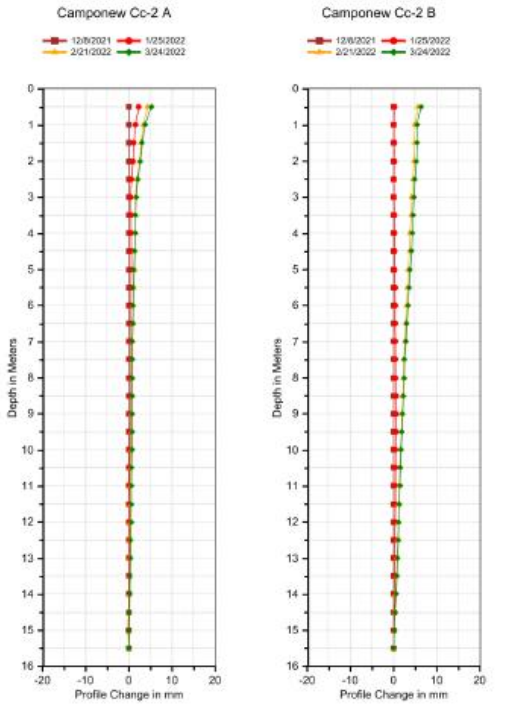


Figure 3-4 CC 3-1

（Not available in May 2022）

3.2 Groundwater Table

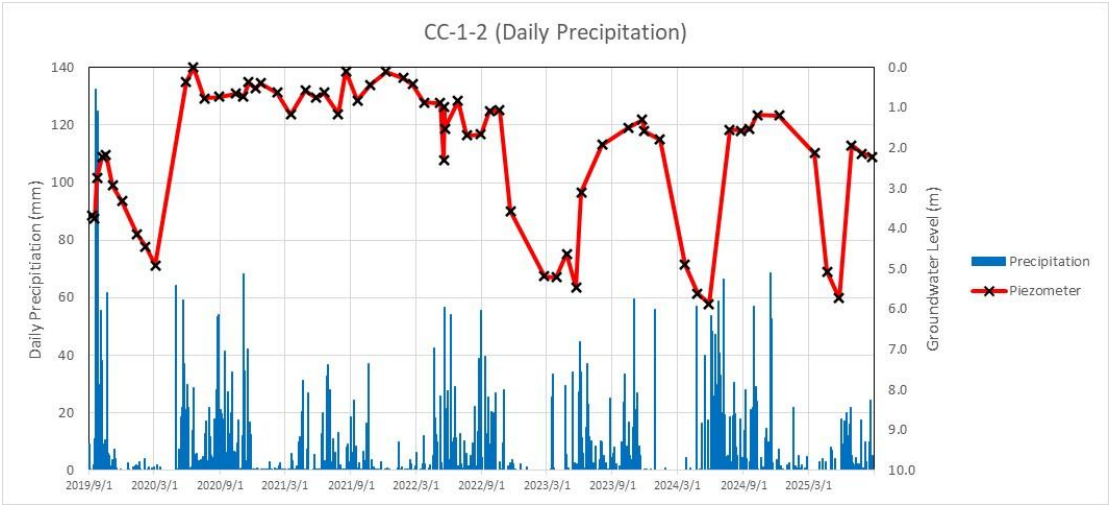


Figure 3-5 Groundwater level at CC 1-2

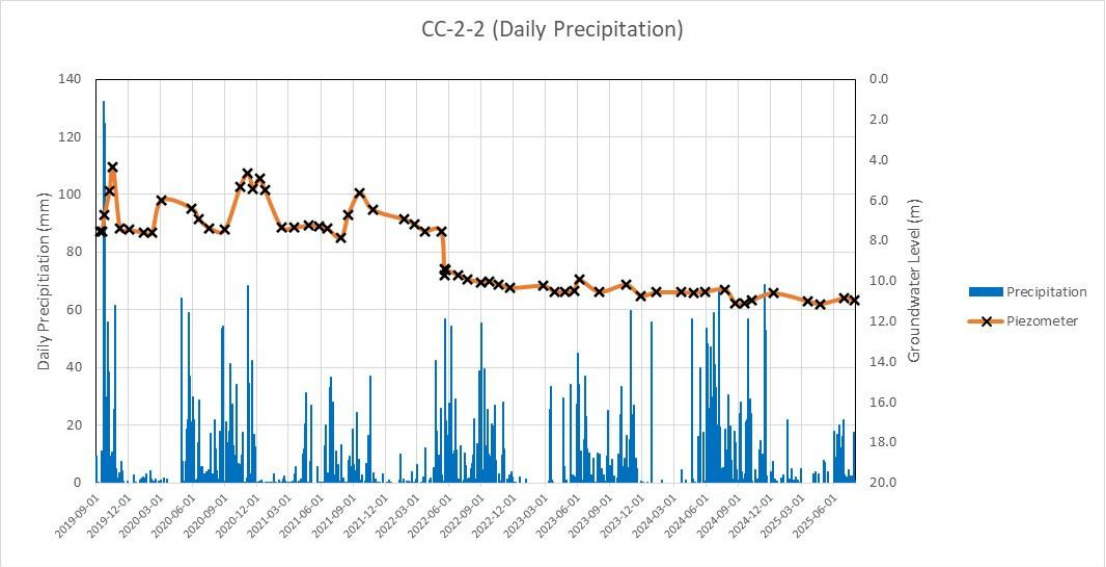


Figure 3-6 Groundwater level at CC 2-2

3.3 Discussion

AMDC-CODEM has been conducting regular monitoring at monitoring wells in the existing landslide area at Campo Cielo, even after the construction of countermeasures, and observed the presence of deformations. No displacement was observed by inclinometer at borehole CC1-1. The groundwater level was confirmed at GL-1.18 m in borehole CC1-2 and GL-10.97 m in borehole CC2-2. In 2024, a steady rainfall began to be observed in May 2024, and a daily rainfall of more than 60 mm was observed in July 2024. The groundwater level in borehole CC1-2 has been as high as GL-1.5 m since July 2024, which is the same level as rainy season in 2023, and further increased to GL-1.2 m in October 2024. In borehole CC1-2, the groundwater level is above the slip surface, but no displacement was observed by the inclinometer in borehole CC1-1. This suggests that the groundwater level in the vicinity of borehole CC1-2 is controlled by the horizontal drainage work.

By September 2025, three years have passed since the landslide countermeasure works were installed in Campo Cielo area. During this period, AMDC have measured landslide movement using borehole inclinometers and groundwater levels monthly. No landslide movement has been detected, and the groundwater level has been maintained below the slip surface. Based on the results, discussions were held with AMDC, JET and CODEM, and it was decided that measurements at Campo Cielo will henceforth be conducted twice a year: before and after the rainy season. Additionally, measurements will be conducted as appropriate in the event of heavy rainfall caused by hurricanes or similar events.

Appendix 5

Result of the investigation on Campo Cielo

Output 1
Analysis of Landslide in Campo Cielo

Technical Workshop

December 2019

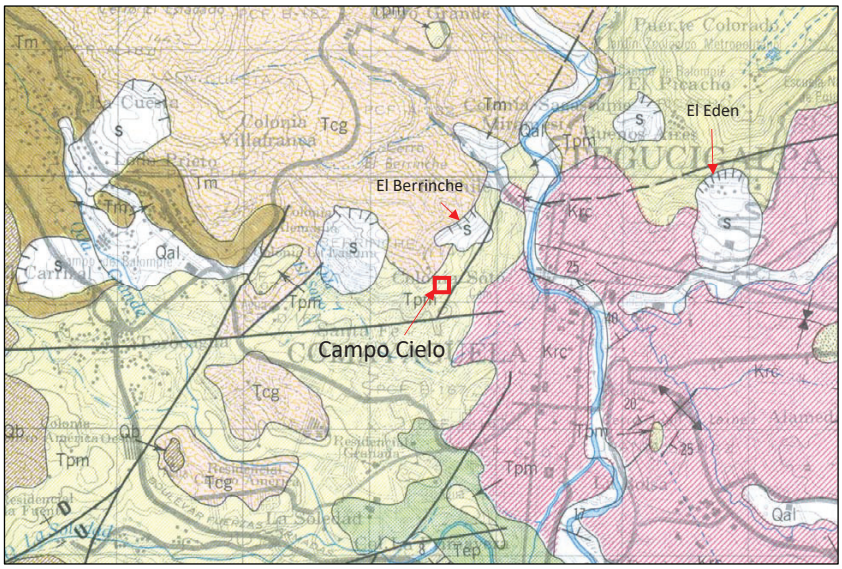
Project for Control and Mitigation of Slope Disaster IN the Central District

Analysis of landslide

1. To comprehend geological and landslide condition
2. To clarify mechanism of landslide
3. Basic concept of countermeasure
4. Stability analysis
    - 3-1. Landslide modeling
    - 3-2. Setting of parameter
    - 3-3. Calculation

Geology

To comprehend the geological situation of the target site.
According to the existing geological map, the target area is distributed Tpm formation from the Miocene to Oligocene. On the site, tuff and Ignimbrite belonging to the Tpm Formation are confirmed on the outcrop. On the other hand, in the drilling survey, sandstone belonging to the Krc formation lower layer of Tpm formation was confirmed at a shallow depth. Both layers contact in noncomformity. It can be confirmed from the observation of the outcrop and the boring core that the upper part of the Krc layer near the boundary with the Tmp layer is partially softened (partially soiled). As the result, it is considered that the target area is widely covered with the Tpm layer, but the lower Krc layer is partially distributed shallowly.



Quaternary

S	Collapse (Landslide)
Qal	Alluvial deposit

Padre Miguel Group (Cenozoic)

Tep	Periodista Member: Sandstone, Volcanic sediments (Miocene)
Tpm	Ignimbrite, Tuff (Oligocene-Miocene)
Tcg	Cerro Grande Member: Ignimbrite (Oligocene)
Tm	Matagalpa Formation: Basalt and andesite (Oligocene)

Valle de Angeles Group (Mesozoic)

Krc	Rio Chiquito Formation: Shale, Limonite, Pink sandstone and conglomerate (Oligocene)

Geological map of Honduras “Tegucigalpa” 1:50,000

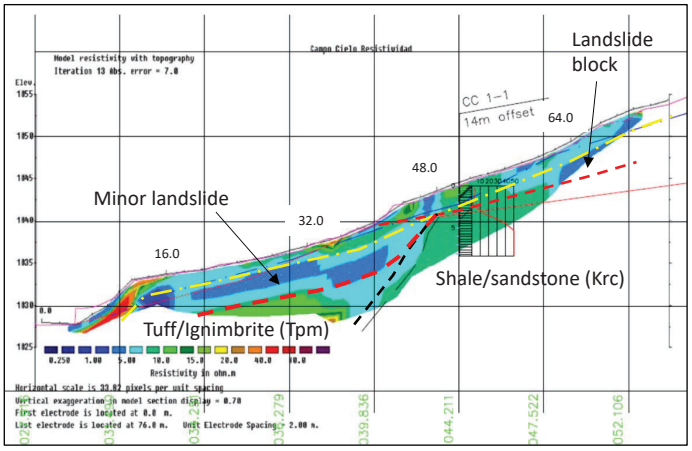
Geology

Tuff
(Tpm formation)

Ignimbrite
(Tpm formation)

Conglomerate
(Tpm formation)

Shale/Sandstone
(Krc formation)



It is an electrical resistivity exploration result figure implemented in the downward slope of a target site.

A continuous boundary between the low resistivity zone and the middle resistivity zone that inclines downstream at the near station 48.0 is confirmed.

It is estimated to be the boundary between the Tpm and Krc layers from the site observation and drilling survey results 。

A lower resistivity zone at valley side is assumed as minor landslide according to its figure.

Landslide

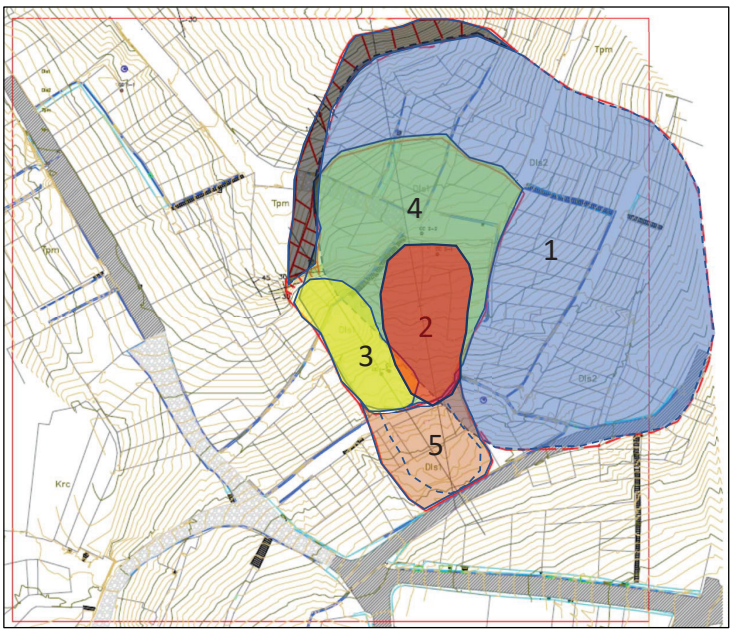
Landslide Area

To comprehend area of target landslides.

Landslides that occurred in 2010-2013 damaged local houses and facilities. After the landslide occurred, Several studies were conducted by AMDC, UNAH and JICA experts. The landslide occurred at that time (2), (3), (4) from those study reports.

As the topographical interpretation based on the topographic map, the existence of old landslide and the scarp were estimated (1). From the positional relationship, the landslide occurred in 2010 is presumed that the part of the old landslide has newly collapsed.

As a result of the field survey, the toe of the slip surface was confirmed. It is considered that the debris of landslide was deposited downward from the back slope of landslide in 2010 (5).

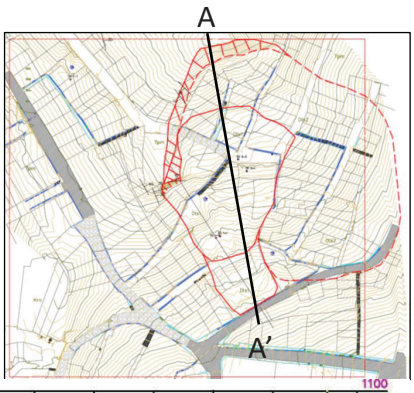


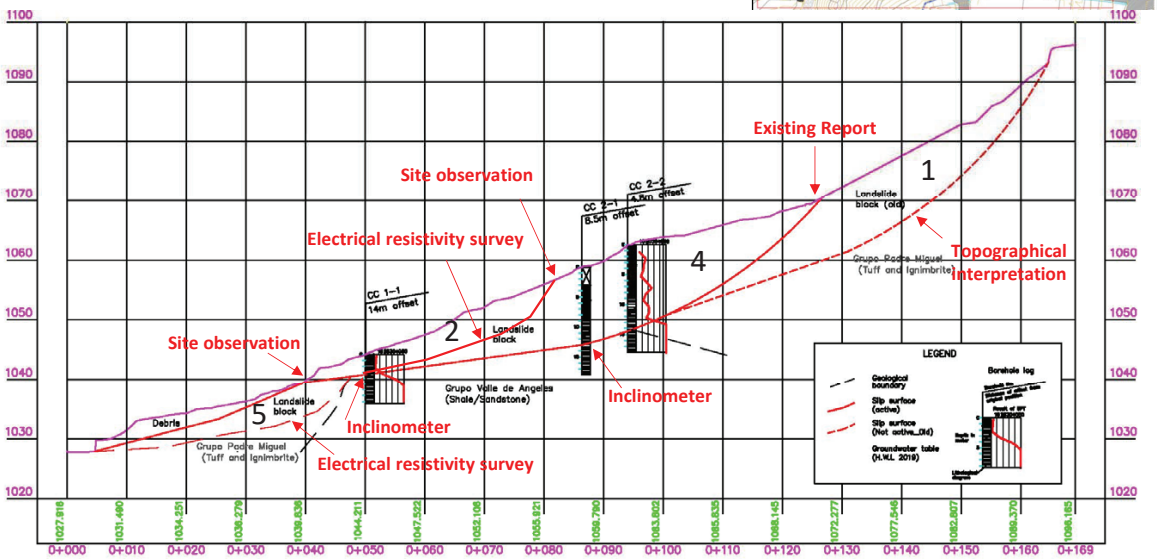
Landslide

Dimensional Figure of Landslide

To comprehend figure of landslides.

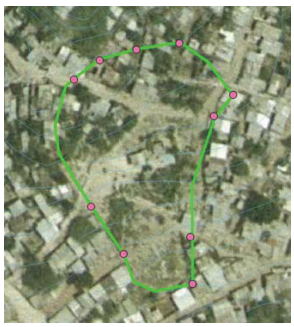
The shape of the landslide block was estimated based on the results of site reconnaissance, drilling survey, geophysical exploration, and borehole inclinometer.





Landslide

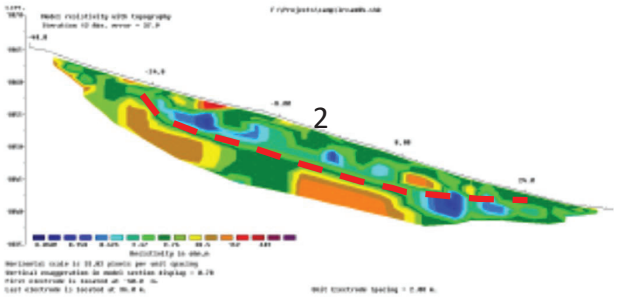
Dimensional Figure of Landslide



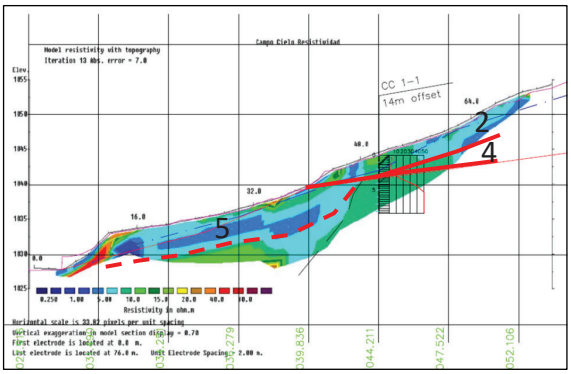
Area of Landslide in 2010

Crack on the wall

Slip surface

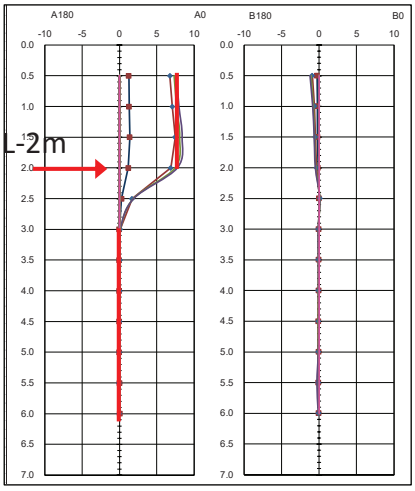


Source: Luis E. Vargas, 2015, Analisis estratigrafico de una zona con alto riesgo al deslizamiento por medio de Metodos de Prospeccion Geofisica



Landslide

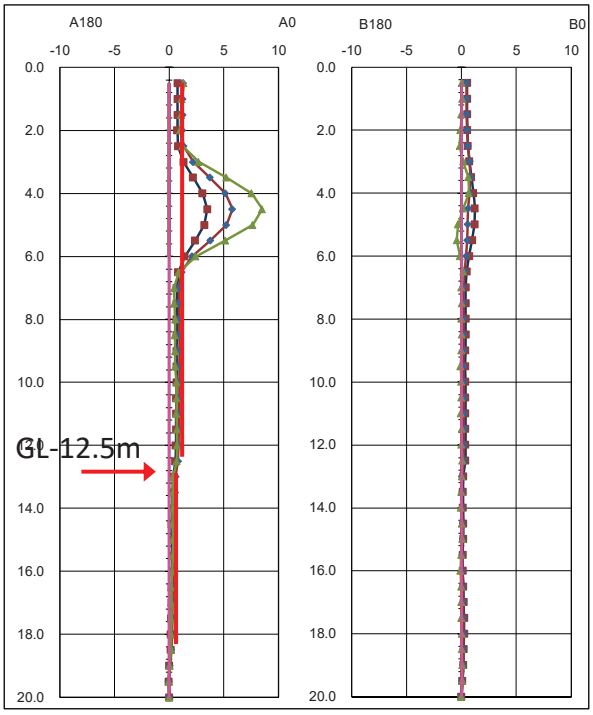
Dimensional Figure of Landslide



Inclinometer at CC 1-1

Displacement that seems to be the movement of the landslide was observed by inclinometer on the each borehole.

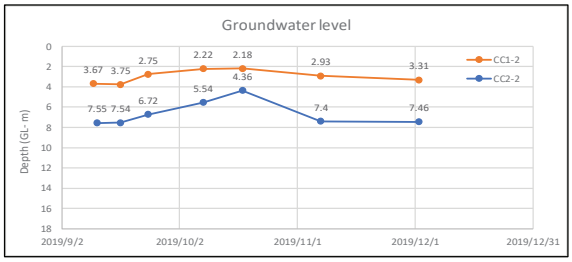
Inclinometer at CC 2-1

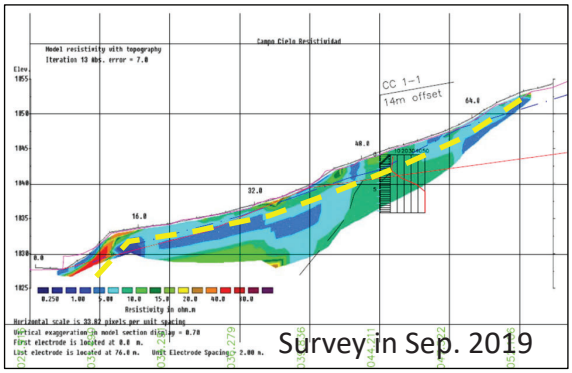


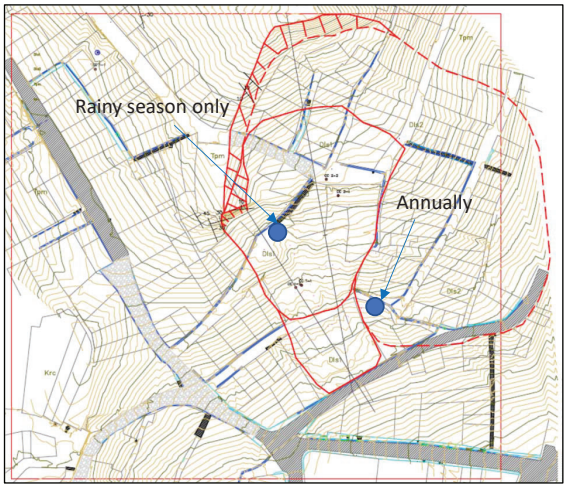
Landslide

Groundwater table

To comprehend the groundwater table in the target site, which is one of the major affecting factors of landslide activity. The groundwater level distribution was estimated based on site reconnaissance, groundwater level measurement and geophysical survey results.







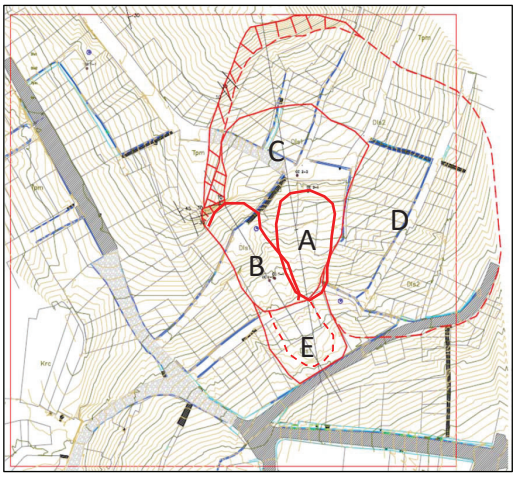
Estimating the groundwater table in the landslide area by connecting these information 。

Landslide

Current status of landslide activity

To comprehend the current status of landslide activities.

Landslide activity will be considered from field observations and inclinometer results.



Landslide A:

A landslide block that was active in 2010. Deformation is seen on the surrounding houses, and Bottom part of the area is extruded to the path. Currently considered the most active block.

Landslide B:

A landslide block that was active in 2010. Activity during the rainy season was confirmed from the results of the inclinometer. It is also the block whose activity is confirmed at present.

Landslide C:

A landslide block that was active in 2010. There were no noticeable deformations in the houses in the area, but minor movements were detected from the results of the inclinometer. The activity of the landslide is considered to be influencing of Landslide A and B.

Landslide D:

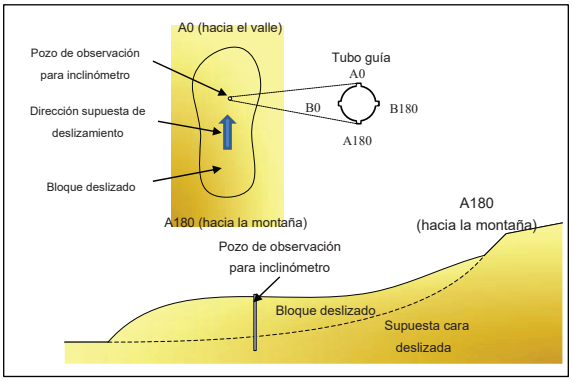
Old landslide block. It is considered stable at the present because there are no deformations in houses within the block area reported.

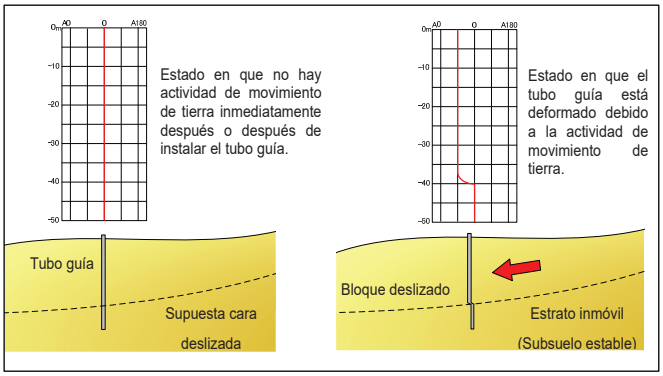
Landslide E:

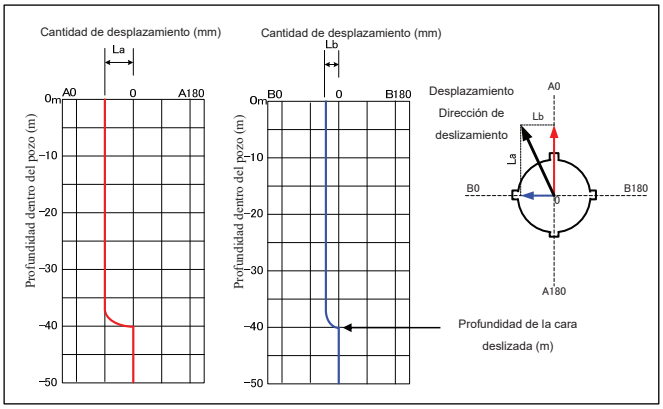
A small block is assumed from the geophysical survey results at the lower part. Since no deformation is seen on the ground surface and the retaining wall at the end, It is considered to be stable.

Landslide

Interpretation of inclinometer data



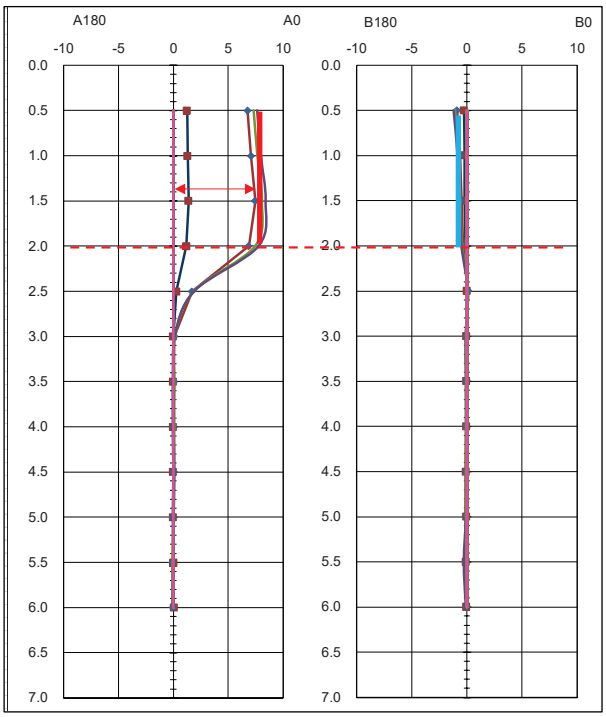


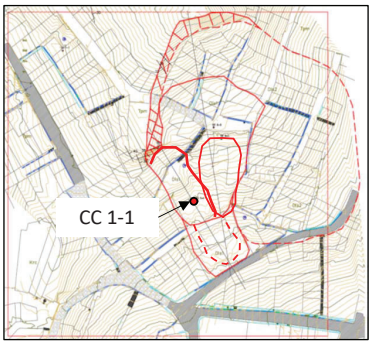


Landslide

Current status of landslide activity

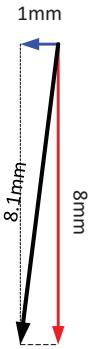
CC 1-1





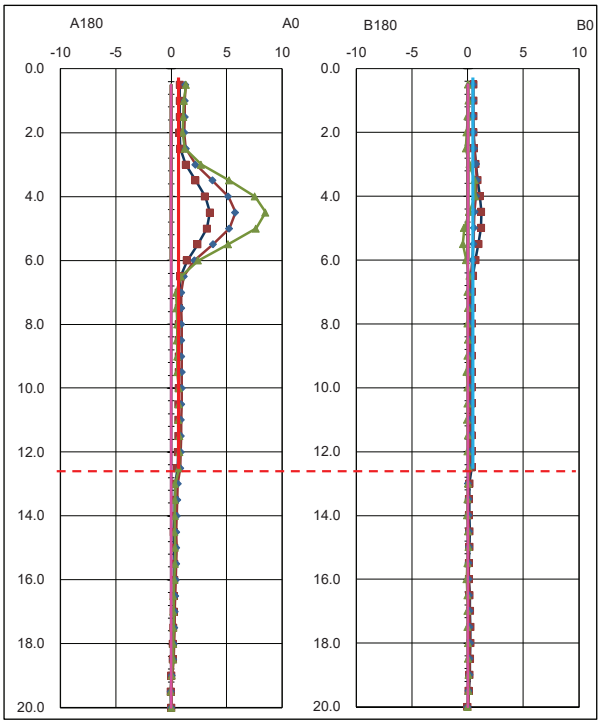
Clear displacement due to a landslide activity is confirmed.

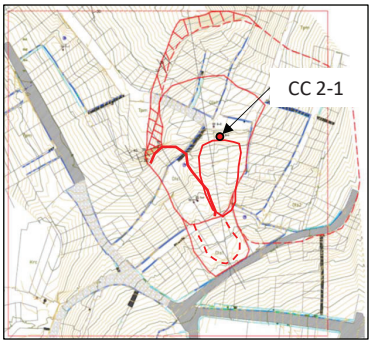
The displacement is about 8mm in the A0 direction (valley side) and about 1mm in the B180 direction (west side). As a result, it can be seen that there was a displacement of 8.1mm about 7 degrees to the west with respect to the A0-180 direction.



Landslide

Current status of landslide activity

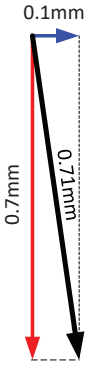




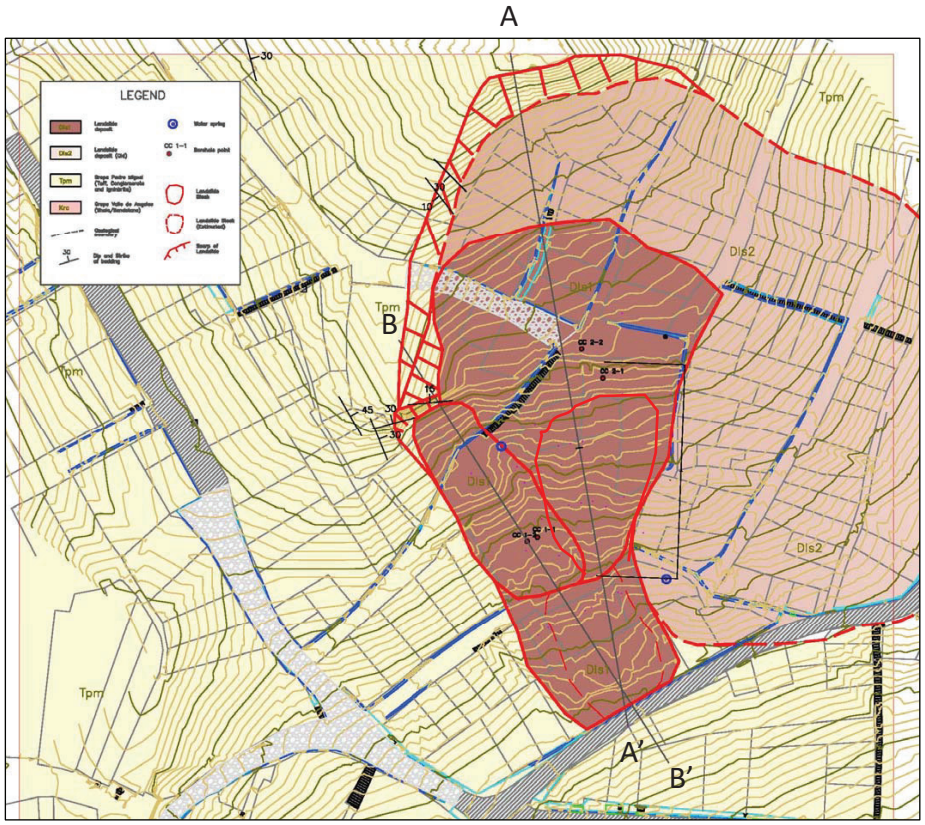
Displacement is observed at a depth of 4-5m. Due to the displacement shape, the possibility of displacement due to landslide is low.

A minute displacement is confirmed from a depth of 12.5m. It is about 0.7mm in the A0 direction (valley side) and about 0.1mm in the B0 direction (east side). As a result, it can be seen that it is displaced about 8 degrees east by 0.71mm from the A0-180 direction.

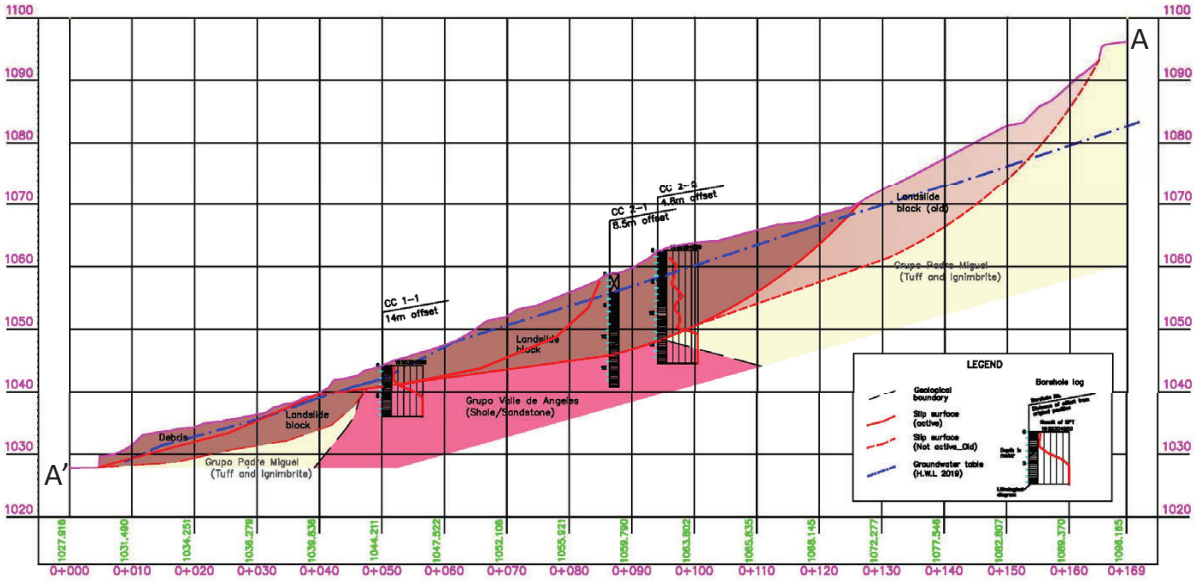
Cumulative displacement of about 1 mm is recognized even at a depth of 5 m, but it is difficult to judge whether it is due to a landslide at this time.



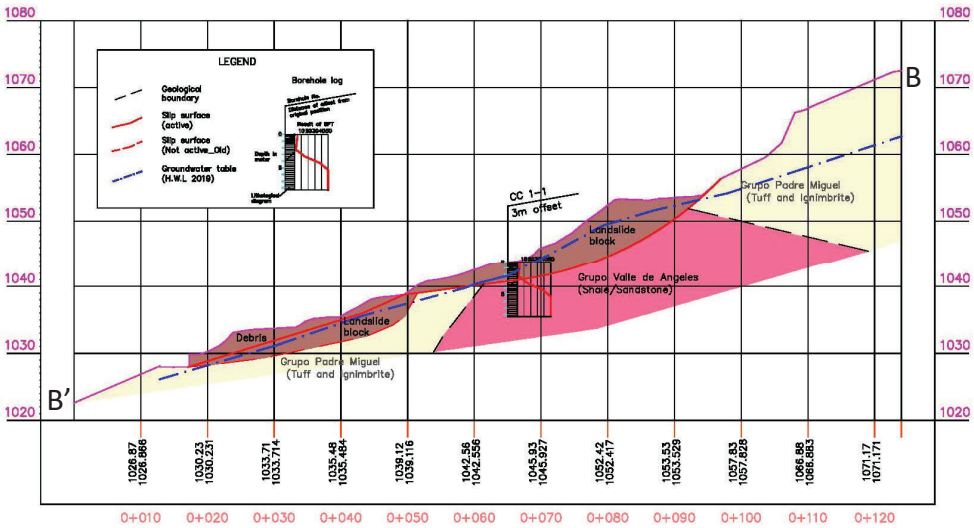
Landslide and geological map



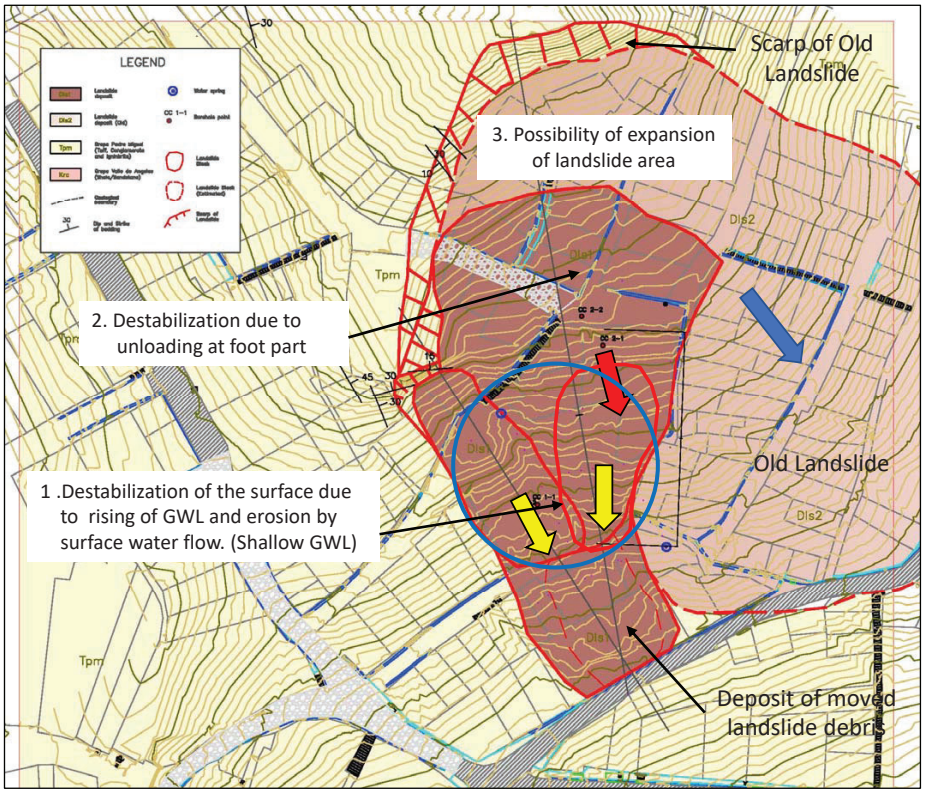
Geological/Landslide cross section



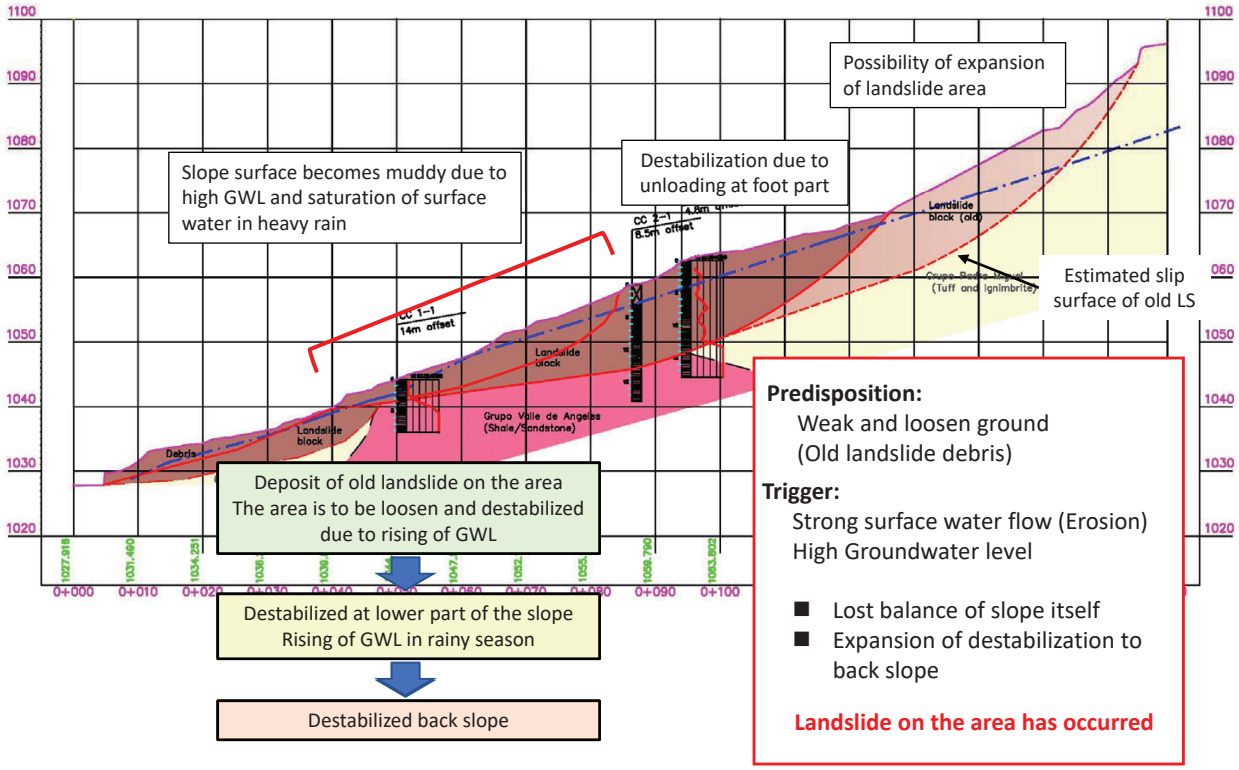
Geological/Landslide cross section



Mechanism of the landslide (1)



Mechanism of the landslide (2)



Basic concept of countermeasure

From the results of the investigation and analysis, the cause of the main landslide is thought to be the rise of groundwater level and the scouring of the lower part of the landslide due to surface water.

Based on this result, the basic concept of countermeasure work is as follows.

- Draw Groundwater table by a drainage: Horizontal drainage
- Control of shallow groundwater and surface water: Channel works, conduit work
- Prevention of sediment runoff at the bottom: Retaining work

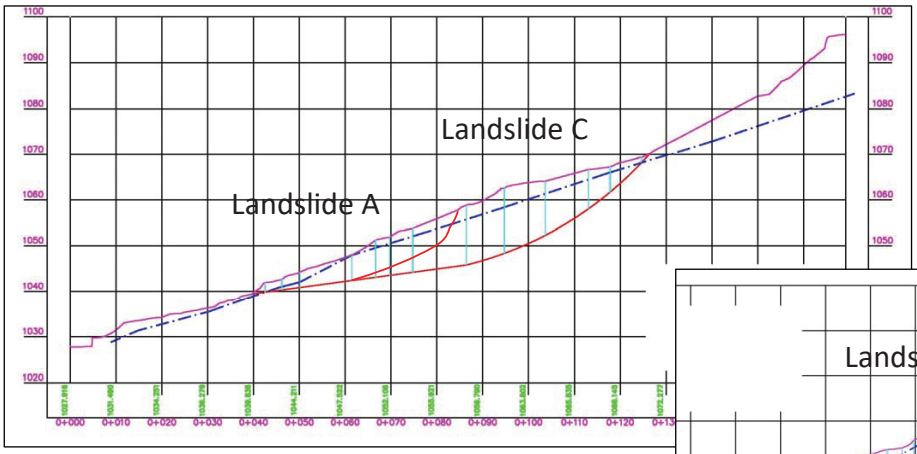
The target safety factor is 1.05 after installing measures. After the above countermeasure works are installed, the situation shall be monitored by inclinometer and groundwater level observation continuously. The stability of the landslides shall be verified based on the groundwater level after the installation. At the same time, the behavior of the landslide after the installation shall be monitored by the inclinometer.

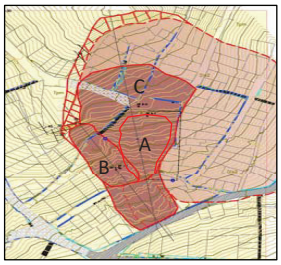
If the target safety factor is not achieved or the inclinometer shows continues to move, additional countermeasures shall be considered.

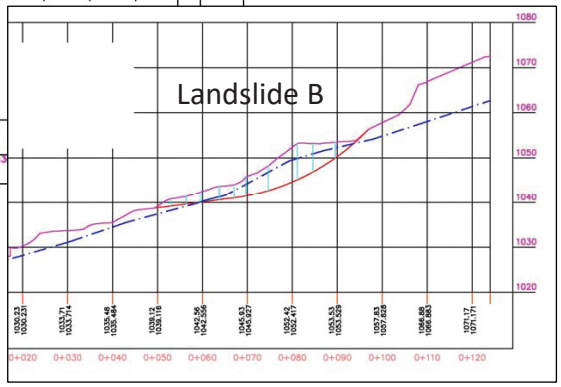
Stability analysis

Before considering landslide countermeasures, it is necessary to set the current safety factor and ground constant. Therefore, a stable calculation is performed.

Modeling of Landslide







Based on the landslide cross section, three landslide slice models were created. For the groundwater level, the data on October 8 and 18 that showed the highest values were applied.

Stability analysis

Setting Parameter

The parameters required for the stability calculation are the unit weight (γt) of the landslide block, the internal friction angle (ϕ) and the cohesion (c) of the slip surface, and the groundwater level. These parameters are set based on laboratory test results.

A direct shear test was conducted using undisturbed samples collected at the end of the slip surface found on the outcrop. The test results are as follows.

Sample No.	Unit weight (kN/m3)	Cohesion (kN/m2)	Internal friction angle (°)	Remarks
1	19.8	12.85	16	Pink sandstone
2	16.2	10.59	19	Pink sandstone/Tuff

It is considered that the materials of the landslide blocks are not uniform because there is variation between both samples. Therefore, the unit weight of the landslide block adopts 18 kN / m3 as the average value of these samples. The landslide surface is presumed to be a mixture of the Tuff of Tpm layer and the Sandstone of the Krc layer. Therefore, the values of sample No. 2 were adopted for the internal friction angle and cohesion for the preliminary calculation of stability.

The groundwater table line is estimated based on the highest water level observed this time.

Stability analysis

Direct Shear Test





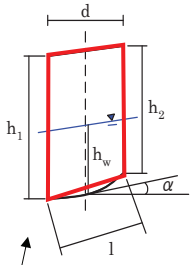

Stability analysis

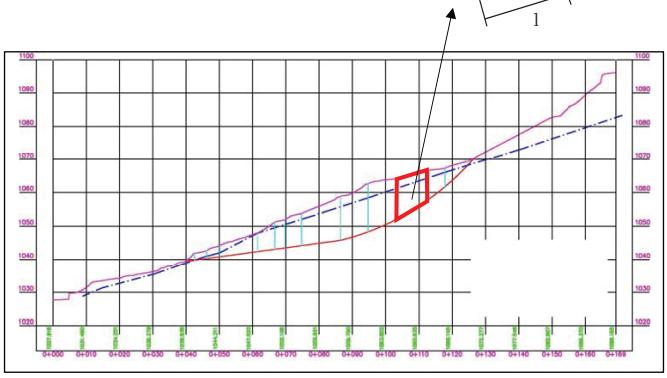
Preliminary Calculation (1)

The stability is calculated using the set constant and landslide model.

The modified Fernius method is used for the stability calculation.

$$Fs = \frac{\sum(c \cdot l + (w - u \cdot d)cos\alpha \cdot tan\varphi)}{\sum(w \cdot sin\alpha)}$$





Where,

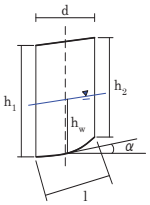
- Fs: Safety factor
- c: Cohesion (kN/m2)
- φ: Internal friction angle (degree)
- w: Weight of slice (kN)
- α: Angle of slip surface (m)
- l: Length of slip surface (m)
- u: Porewater pressure (kN/m2)
- d: Width of slice (m)

Stability analysis

Preliminary Calculation (2)

Modified Fellenius method

$$Fs = \frac{S}{T} = \frac{\sum\{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = 0.90$$



Soil Constants (Soil Parameter)

No.	Strata	Geological Material	Unit Weight γ_t (kN/m³)	Unit Weight γ_{sat} (kN/m³)	Cohesion c (kN/m²)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ
1	Dls1	Sandy silt	18.00		10.59	19.0	0.3443
2							0.0000
3							0.0000

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m²)	Unit Weight γ_t (kN/m³)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h1 (m)	W.L. Height h2 (m)	W.L. Height h_w (m)	Pore Water P U (kN/m²)	Cohesion c (kN/m²)	tanφ	S	T
1	Dls1	Sandy silt	0.00	2.11	2.74	2.89	18.00	52.03	2.76	8.0	0.00	0.00	0.00	0.00	10.59	0.344	46.970	7.242
2	Dls1	Sandy silt	2.11	2.32	3.70	8.20	18.00	147.52	3.73	8.0	0.00	0.70	0.35	3.43	10.59	0.344	85.471	20.531
3	Dls1	Sandy silt	2.32	3.37	3.91	11.12	18.00	200.23	3.94	8.0	0.70	1.19	0.95	9.27	10.59	0.344	97.643	27.867
4	Dls1	Sandy silt	3.37	5.55	11.37	50.71	18.00	912.78	11.47	8.0	1.19	5.55	3.37	33.05	10.59	0.344	304.580	127.03
5	Dls1	Sandy silt	5.55	8.16	5.20	35.65	18.00	641.63	5.25	8.0	5.55	6.46	6.01	58.89	10.59	0.344	169.963	89.297
6	Dls1	Sandy silt	8.16	8.38	3.10	25.64	18.00	461.47	3.12	8.0	6.46	6.99	6.73	65.95	10.59	0.344	120.679	64.224
7	Dls1	Sandy silt	8.38	9.57	5.00	44.88	18.00	807.75	5.05	8.0	6.99	7.86	7.43	72.81	10.59	0.344	204.763	112.417
8	Dls1	Sandy silt	9.57	13.00	11.63	131.24	18.00	2362.40	11.74	8.0	7.86	9.90	8.88	87.08	10.59	0.344	584.518	328.783
9	Dls1	Sandy silt	13.00	14.21	8.37	113.87	18.00	2049.73	8.75	17.0	9.90	10.03	9.97	97.72	10.59	0.344	498.267	599.283
10	Dls1	Sandy silt	14.21	11.78	8.86	115.14	18.00	2072.44	9.69	24.0	10.03	9.04	9.54	93.51	10.59	0.344	493.921	842.938
11	Dls1	Sandy silt	11.78	8.59	9.45	96.25	18.00	1732.47	11.07	31.0	9.04	6.39	7.72	75.66	10.59	0.344	417.542	892.287
12	Dls1	Sandy silt	8.59	5.55	4.72	33.37	18.00	600.67	5.96	38.0	6.39	4.30	5.35	52.42	10.59	0.344	158.968	369.808
13	Dls1	Sandy silt	5.55	1.25	6.81	23.15	18.00	416.77	9.37	43.0	4.30	0.00	2.15	21.08	10.59	0.344	168.024	284.238
14	Dls2	Sandy silt	1.25	0.00	2.04	1.28	18.00	22.95	3.05	48.0	0.00	0.0	0.00	0.00	10.59	0.344	37.587	17.055
																Σ	3388.90	3783.00

Stability analysis

Verification of the Preliminary calculation result

Dose the safety factor obtained the calculation match the actual site situation?

- Fs=0.95: Moving landslide continuously
- Fs=0.98: Moving landslide seasonally/small movement

Are the strength parameters representing values of whole slip surface ?

The applied parameters shows a part of slip surface. Condition of the whole stretch of slip surface shall not be uniformity, but various conditions.

Should we re-consider the applied parameters to match the actual site situation? How?

Stability analysis

Back analysis

To estimate the appropriate parameters, Back analysis can be used.

Back analysis assumes the current safety factor and estimates c and ϕ based on it.

In general, when there is no laboraoty test result, c is assumed from the thickness of the landslide block, and ϕ that matches the current safety factor is calculated. Japanese guidelines * suggests the following theory.

Vertical landslide thickness (m) = Cohesion (c) (kN / m2).

Since there are laboratory test results this time, the test result ϕ was fixed and c was calculated.

The current safety factor is assumed to be Fs = 0.98 because the target landslide moves in the rainy season.

*"Highway Earthwork series – Manual for Slope protection", Japan Road Association, 2009

Stability analysis

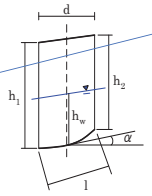
Back analysis calculation

Modified Fellenius method

$$Fs = \frac{S}{T} = \frac{\sum\{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = 0.98$$

Soil Constants (Soil Parameter)

No.	Strata	Geological Material	Unit Weight γ_t (kN/m^3)	Unit Weight γ_{sat} (kN/m^3)	Cohesion c (kN/m^2)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ
1	Dls1	Sandy silt	18.00		14.0	19.0	0.3443
2							0.0000
3							0.0000
4							0.0000
5							0.0000



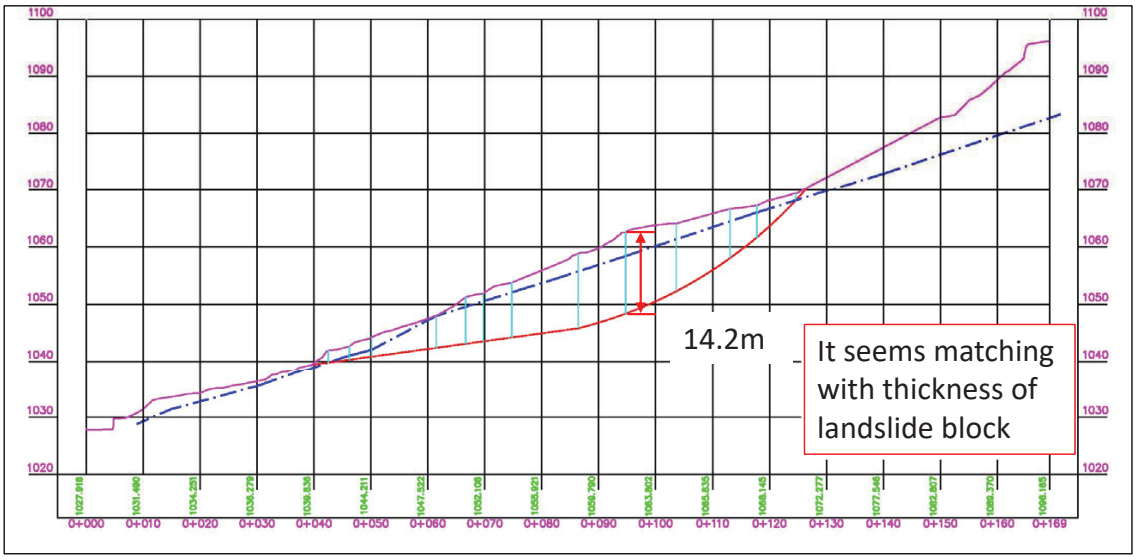
C=14.0kN/m2

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h1 (m)	W.L. Height h2 (m)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ	S	T
1	Dls1	Sandy silt	0.00	2.11	2.74	2.89	18.00	52.03	2.76	8.0	0.00	0.00	0.00	0.00	14.00	0.344	56.382	7.242
2	Dls1	Sandy silt	2.11	2.32	3.70	8.20	18.00	147.52	3.73	8.0	0.00	0.70	0.35	3.43	14.00	0.344	98.190	20.531
3	Dls1	Sandy silt	2.32	3.37	3.91	11.12	18.00	200.23	3.94	8.0	0.70	1.19	0.95	9.27	14.00	0.344	111.079	27.867
4	Dls1	Sandy silt	3.37	5.55	11.37	50.71	18.00	912.78	11.47	8.0	1.19	5.55	3.37	33.05	14.00	0.344	343.692	127.03
5	Dls1	Sandy silt	5.55	8.16	5.20	35.65	18.00	641.63	5.25	8.0	5.55	6.46	6.01	58.89	14.00	0.344	187.865	89.297
6	Dls1	Sandy silt	8.16	8.38	3.10	25.64	18.00	461.47	3.12	8.0	6.46	6.99	6.73	65.95	14.00	0.344	131.318	64.224
7	Dls1	Sandy silt	8.38	9.57	5.00	44.88	18.00	807.75	5.05	8.0	6.99	7.86	7.43	72.81	14.00	0.344	221.984	112.417
8	Dls1	Sandy silt	9.57	13.00	11.63	131.24	18.00	2362.40	11.74	8.0	7.86	9.90	8.88	87.08	14.00	0.344	624.551	328.783
9	Dls1	Sandy silt	13.00	14.21	8.37	113.87	18.00	2049.73	8.75	17.0	9.90	10.03	9.97	97.72	14.00	0.344	528.105	599.283
10	Dls1	Sandy silt	14.21	11.78	8.86	115.14	18.00	2072.44	9.69	24.0	10.03	9.04	9.54	93.51	14.00	0.344	526.964	842.938
11	Dls1	Sandy silt	11.78	8.59	9.45	96.25	18.00	1732.47	11.07	31.0	9.04	6.39	7.72	75.66	14.00	0.344	455.291	892.287
12	Dls1	Sandy silt	8.59	5.55	4.72	33.37	18.00	600.67	5.96	38.0	6.39	4.30	5.35	52.42	14.00	0.344	179.292	369.808
13	Dls1	Sandy silt	5.55	1.25	6.81	23.15	18.00	416.77	9.37	43.0	4.30	0.00	2.15	21.08	14.00	0.344	199.976	284.238
14	Dls2	Sandy silt	1.25	0.00	2.04	1.28	18.00	22.95	3.05	48.0	0.00	0.0	0.00	0.00	14.00	0.344	47.988	17.055
																Σ	3712.68	3783.00

Stability analysis

Verification of the Back Analysis result

Dose the cohesion obtained from the calculation is reasonable?



Stability analysis

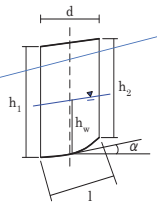
Back analysis calculation –Landslide A

Modified Fellenius method

$$Fs = \frac{S}{T} = \frac{\sum \{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = 0.98$$

Soil Constants (Soil Parameter)

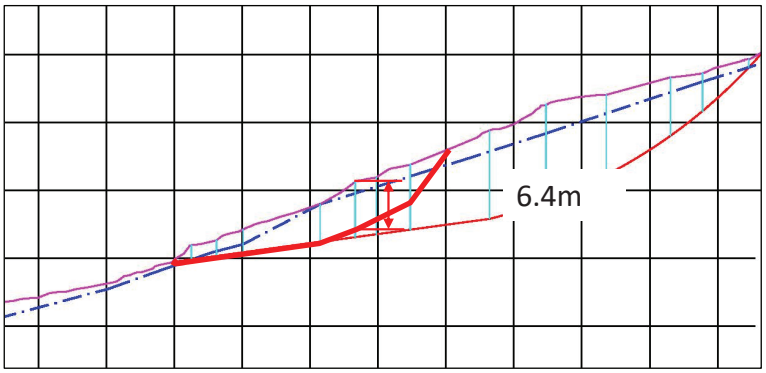
No.	Strata	Geological Material	Unit Weight γ_t (kN/m^3)	Unit Weight γ_{sat} (kN/m^3)	Cohesion c (kN/m^2)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ
1	Dls1	Sandy silt	18.00		6.5	19.0	0.3443
2							0.0000
3							0.0000
4							0.0000
5							0.0000



C=6.5kN/m2

Thickness of landslide=6.4m

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h1 (m)	W.L. Height h2 (m)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ	S	T
1	Dls1	Sandy silt	0.00	2.11	2.74	2.89	18.00	52.03	2.76	8.0	0.00	0.00	0.00	0.00	6.50	0.344	35.682	7.242



Stability analysis

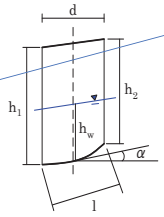
Back analysis calculation –Landslide d B

Modified Fellenius method

$$Fs = \frac{S}{T} = \frac{\sum \{c \cdot l + (W - U \cdot d)\cos\alpha \cdot \tan\phi\}}{\sum W \cdot \sin\alpha} = 0.98$$

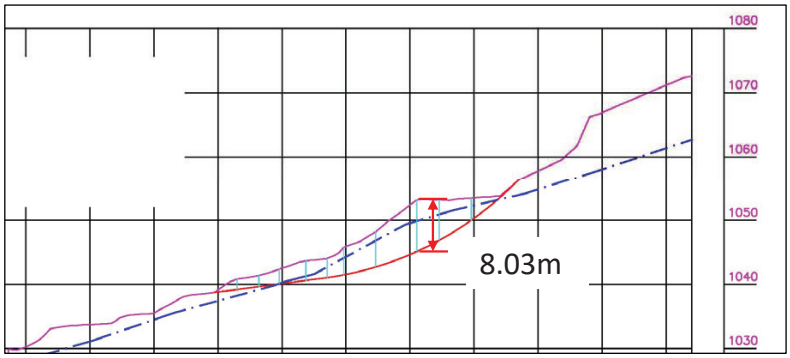
Soil Constants (Soil Parameter)

No.	Strata	Geological Material	Unit Weight γ_t (kN/m^3)	Unit Weight γ_{sat} (kN/m^3)	Cohesion c (kN/m^2)	Internal Friction Angle φ (°)	Internal Friction Angle tanφ
1	Dls1	Sandy silt	18.00		6.5	19.0	0.3443
2							0.0000
3							0.0000
4							0.0000
5							0.0000



C=6.5kN/m2

Slice No.	Strata	Geological Material	Height (L) h_1 (m)	Height (R) h_2 (m)	Wide d (m)	Area A (m^2)	Unit Weight γ_t (kN/m^3)	Weight W (kN/m)	Length l (m)	Angle α (°)	W.L. Height h1 (m)	W.L. Height h2 (m)	W.L. Height h_w (m)	Pore Water P U (kN/m^2)	Cohesion c (kN/m^2)	tanφ	S	T
1	Dls1	Sandy silt	0.00	1.64	3.42	2.80	18.00	50.48	3.44	7.0	0.00	0.00	0.00	0.00	6.50	0.344	39.612	6.152



Stability analysis

Parameter for each landslide block

Landslide	Unit weight (kN/m3)	Cohesion (kN/m2)	Internal friction angle (°)
A	18	6.5	19
B	18	6.5	19
C	18	14	19

Conclusion

- There are 3 active landslide blocks on the area.
- Those landslides seem activated in rainy season.
- Predisposition of landslides is weak and loosen material of old landslide block
- Triggers of landslide are erosion by surface water and increasing of porewater pressure by rising of groundwater level.
- The activities of the Landslide A and B give affect of instability of the Landslide C and further area behind the landslide.
- Countermeasure will be planned to solve the triggers of landslide occurred.
- Design of countermeasure work shall be applied parameter set in the analysis.

Appendix 6

Result of the investigation on Fuerzas Unidas

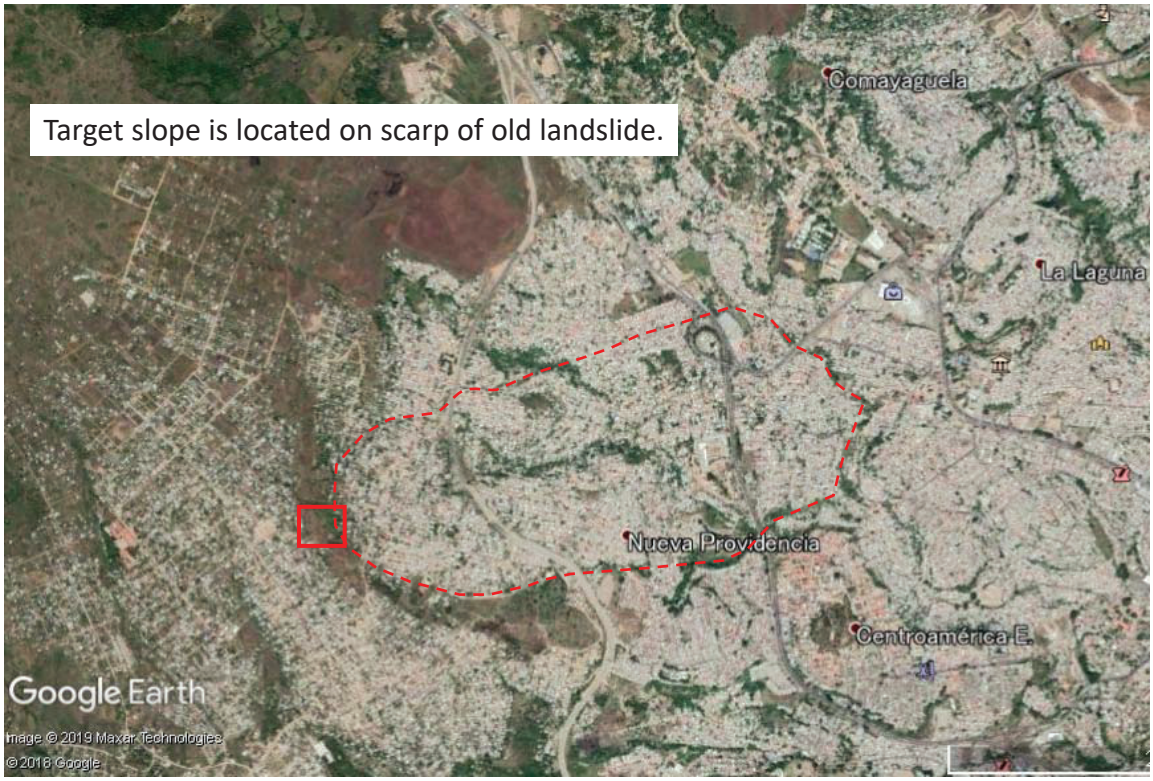
Output 1
Investigation and Analysis for rockfall in Fuerzas Unidas

Technical Workshop

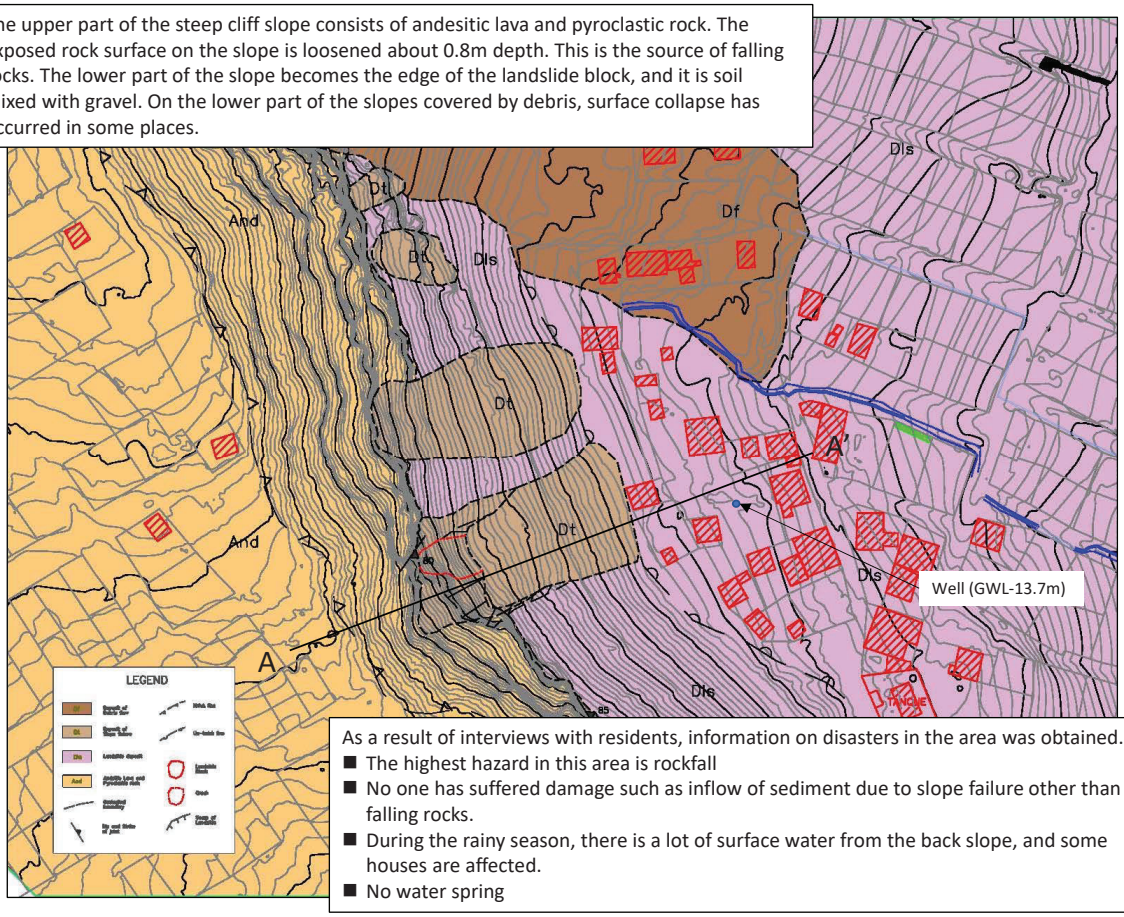
December 2019

Project for Control and Mitigation of Slope Disaster IN the Central District

Fuerzas Unidas



The upper part of the steep cliff slope consists of andesitic lava and pyroclastic rock. The exposed rock surface on the slope is loosened about 0.8m depth. This is the source of falling rocks. The lower part of the slope becomes the edge of the landslide block, and it is soil mixed with gravel. On the lower part of the slopes covered by debris, surface collapse has occurred in some places.

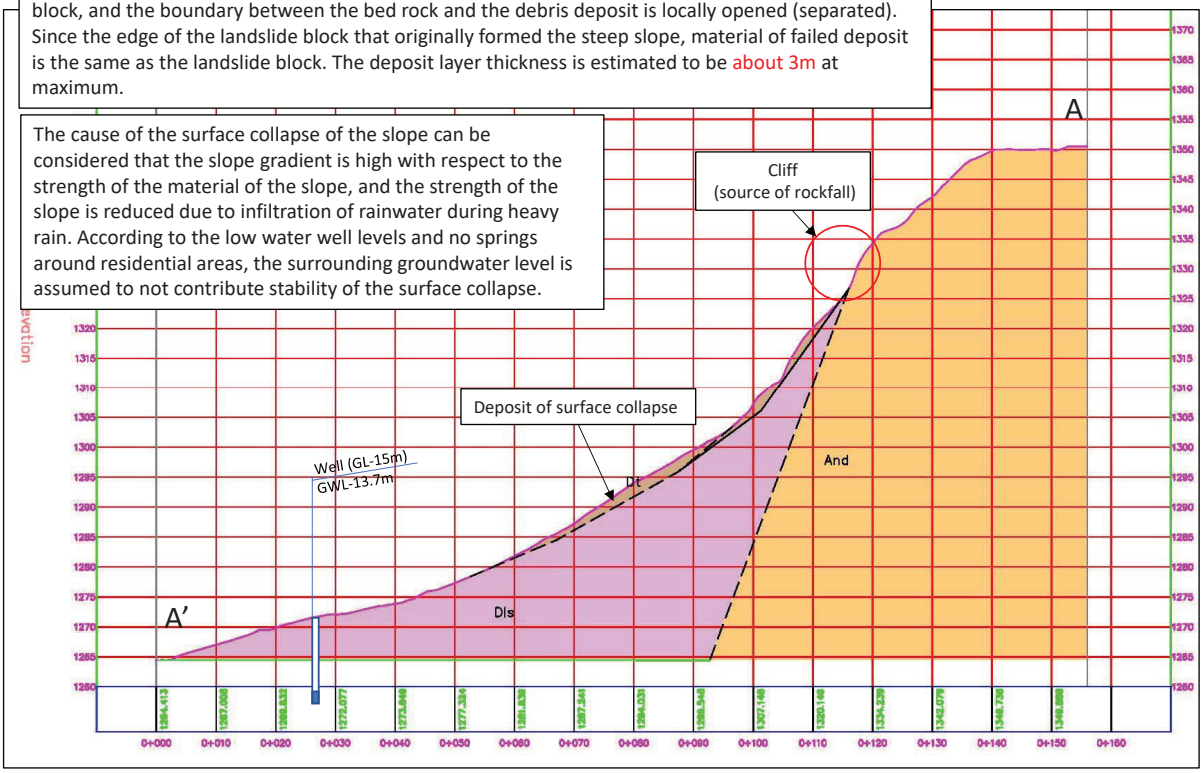


As a result of interviews with residents, information on disasters in the area was obtained.

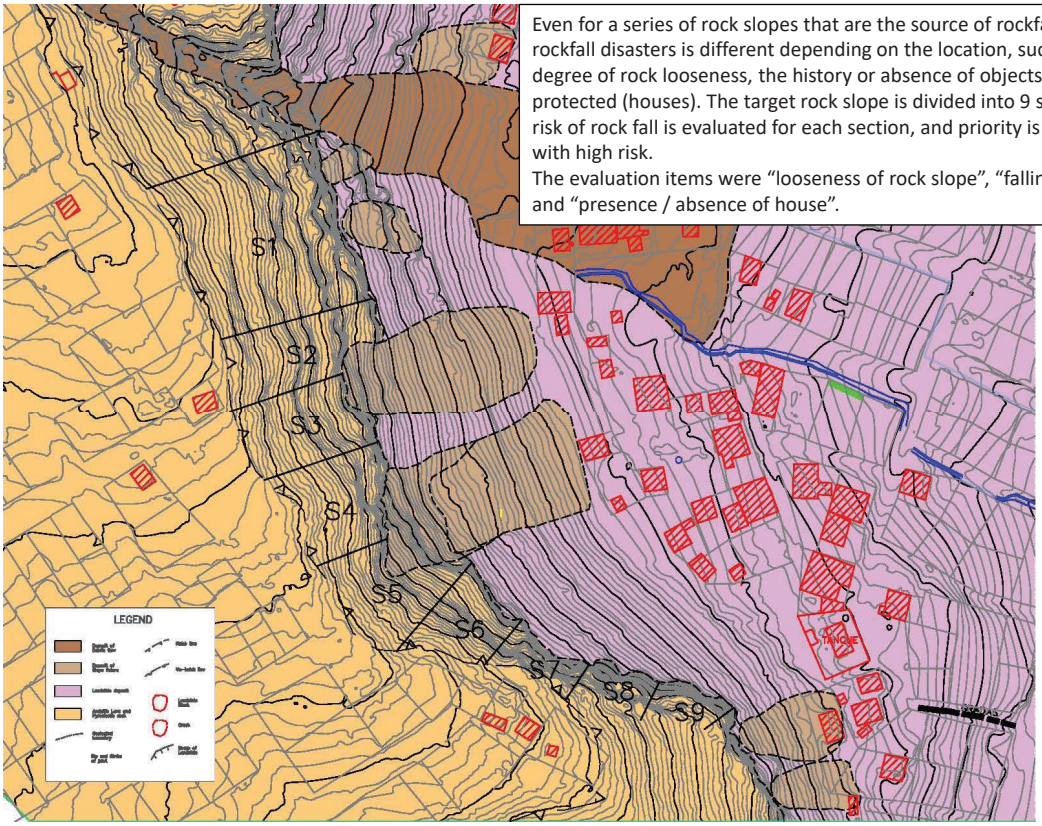
- The highest hazard in this area is rockfall
- No one has suffered damage such as inflow of sediment due to slope failure other than falling rocks.
- During the rainy season, there is a lot of surface water from the back slope, and some houses are affected.
- No water spring

The steep cliff that is exposed on the rock slope is the source of rock fall
The surface collapses have occurred at the steep debris slope that is part of the edge of the landslide block, and the boundary between the bed rock and the debris deposit is locally opened (separated). Since the edge of the landslide block that originally formed the steep slope, material of failed deposit is the same as the landslide block. The deposit layer thickness is estimated to be about 3m at maximum.

The cause of the surface collapse of the slope can be considered that the slope gradient is high with respect to the strength of the material of the slope, and the strength of the slope is reduced due to infiltration of rainwater during heavy rain. According to the low water well levels and no springs around residential areas, the surrounding groundwater level is assumed to not contribute stability of the surface collapse.

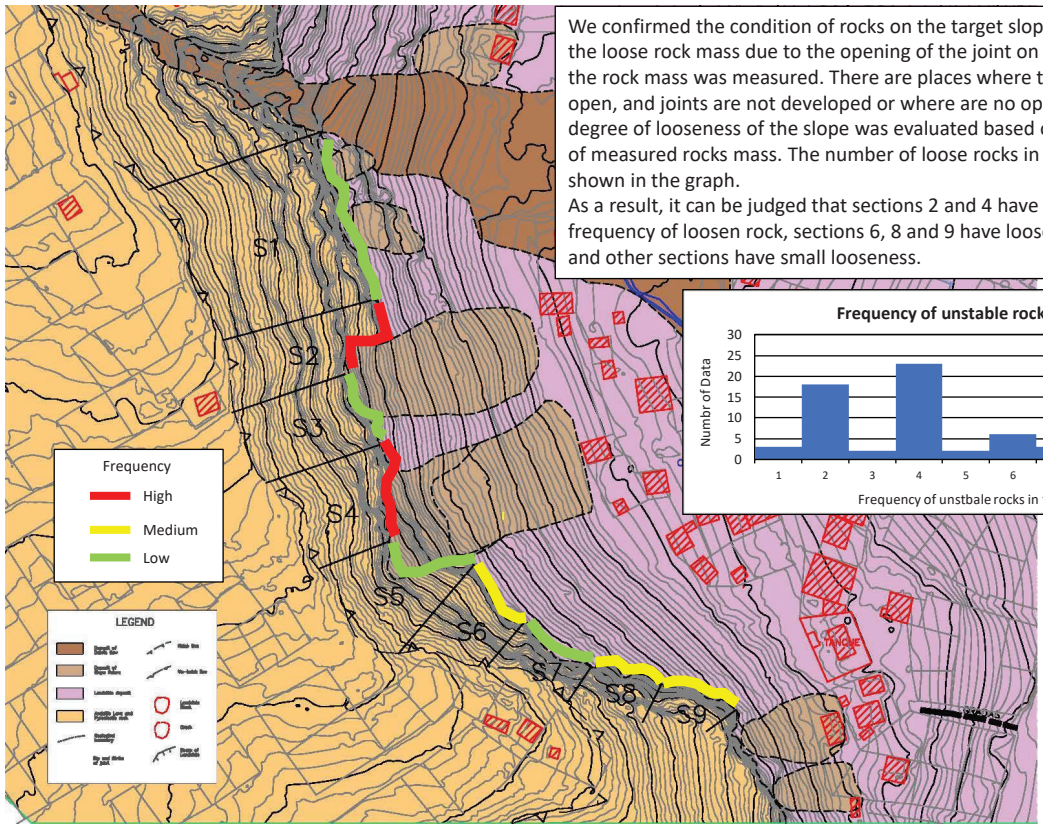


Risk Evaluation/Prioritization



Even for a series of rock slopes that are the source of rockfall, the risk of rockfall disasters is different depending on the location, such as the degree of rock looseness, the history or absence of objects to be protected (houses). The target rock slope is divided into 9 sections, the risk of rock fall is evaluated for each section, and priority is given to areas with high risk.
The evaluation items were “looseness of rock slope”, “falling rock history”, and “presence / absence of house”.

Instability of Rock slope



We confirmed the condition of rocks on the target slope. The size of the loose rock mass due to the opening of the joint on the surface of the rock mass was measured. There are places where the joints are open, and joints are not developed or where are no open joints. The degree of looseness of the slope was evaluated based on the number of measured rocks mass. The number of loose rocks in each section is shown in the graph.
As a result, it can be judged that sections 2 and 4 have the high frequency of loosen rock, sections 6, 8 and 9 have looseness locally, and other sections have small looseness.

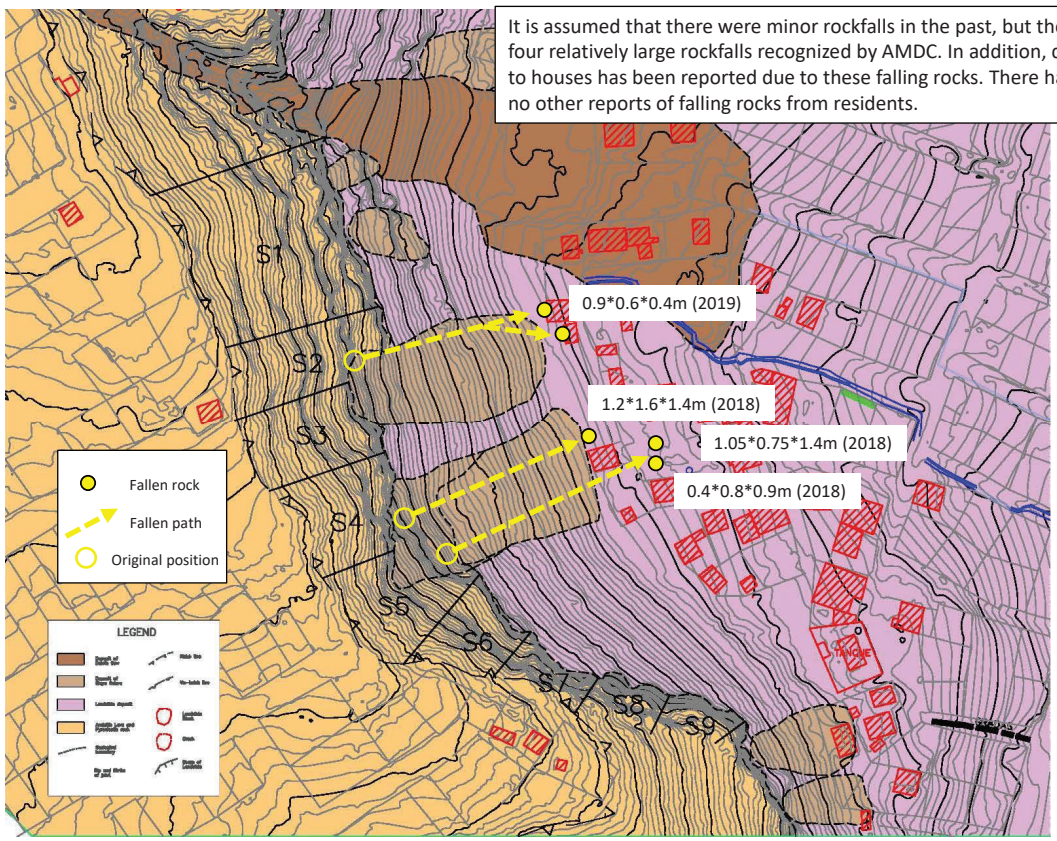
Measurement of loosen rocks



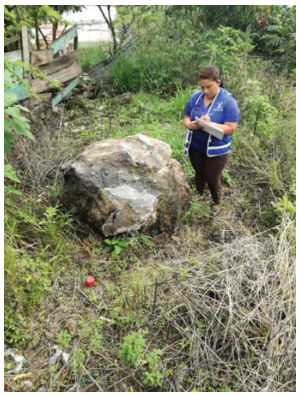




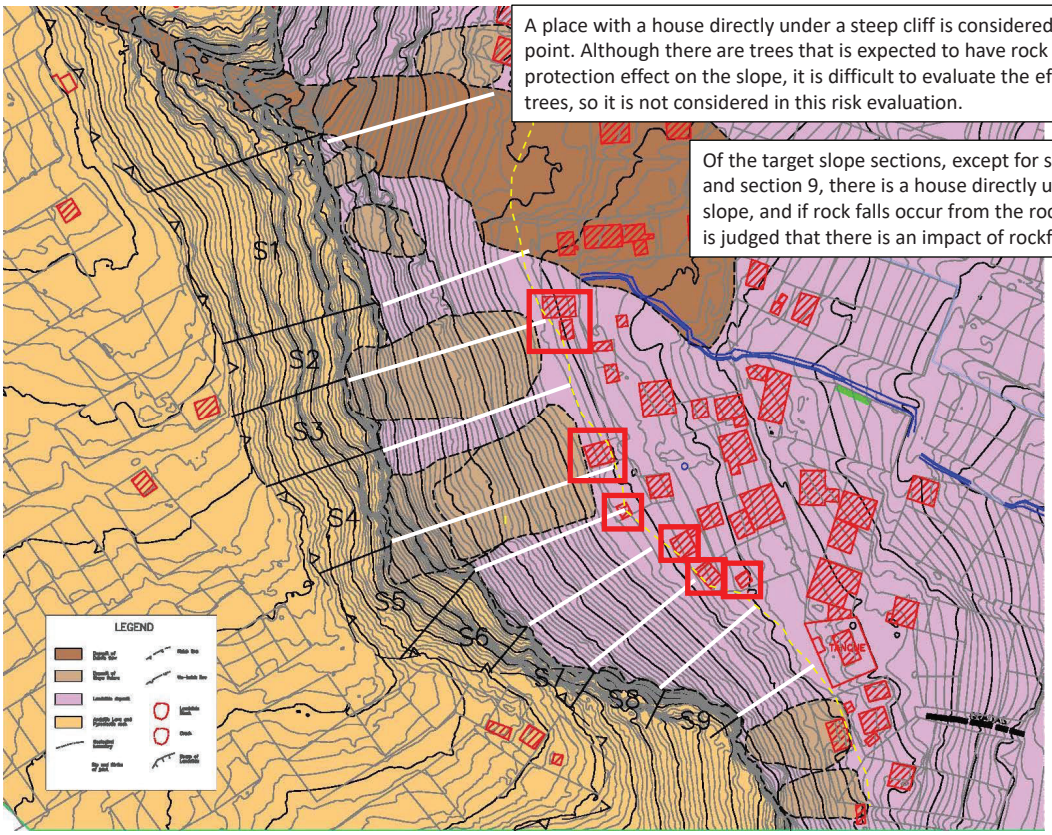

History of rockfall



Fallen rocks at site



Conservation target (Houses)



A place with a house directly under a steep cliff is considered a hig risk point. Although there are trees that is expected to have rock fall protection effect on the slope, it is difficult to evaluate the effect of the trees, so it is not considered in this risk evaluation.

Of the target slope sections, except for section 1 and section 9, there is a house directly under the slope, and if rock falls occur from the rock slope, it is judged that there is an impact of rockfall disaster.

Result of Risk evaluation

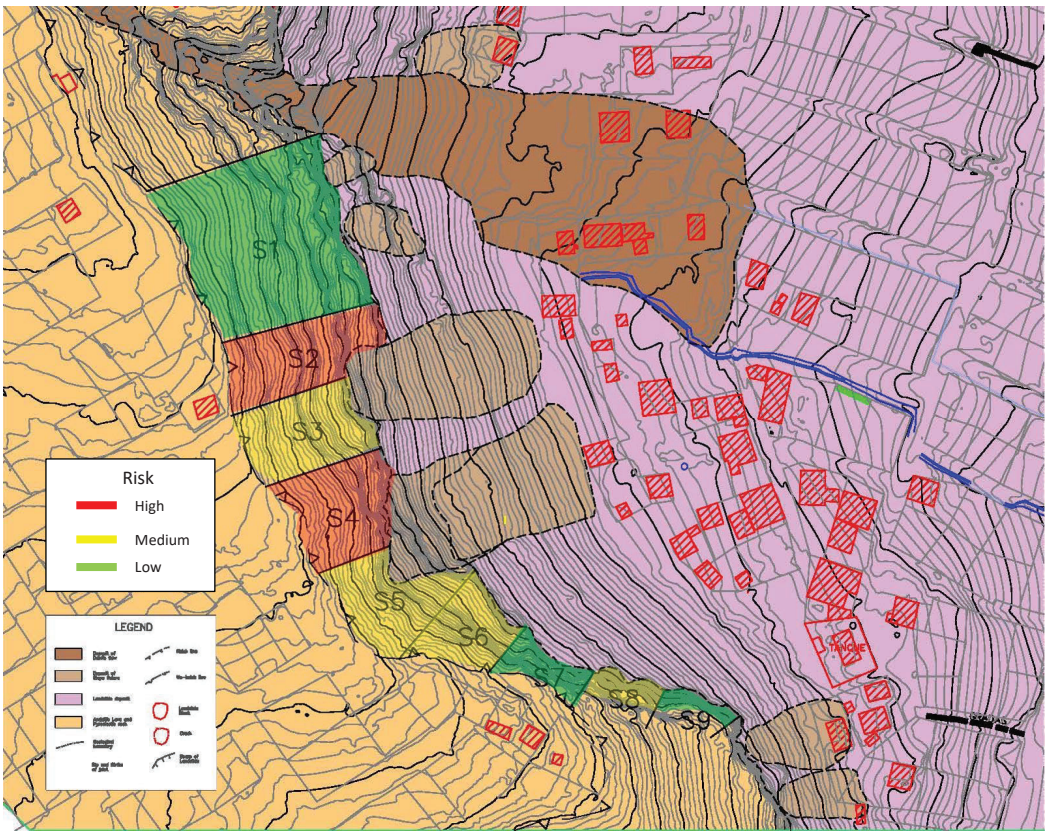
Section	Instability	History	House	Risk rank
1	Low	N	N	III
2	High	Y	Y	I
3	Low	N	Y	II
4	High	Y	Y	I
5	Low	Y	Y	II
6	Med	N	Y	II
7	Low	N	Y	III
8	Med	N	Y	II
9	Med	N	N	III

Matrix for Risk evaluation

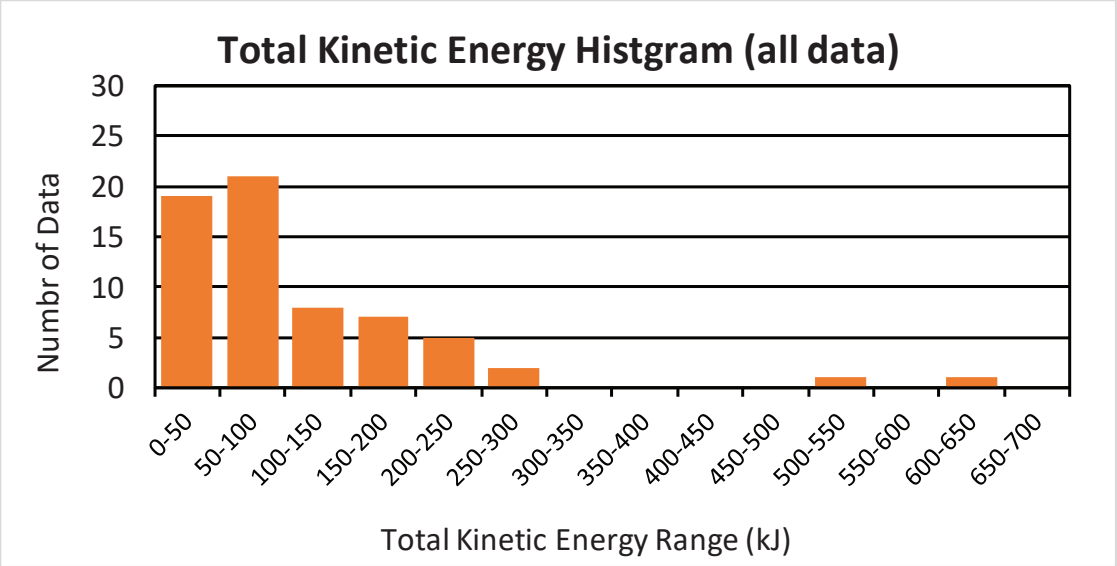
House	History	Instability		
		High	Med	Low
Y	Y	I	I	II
	N	I	II	II
N	Y	III	III	III
	N	III	III	III

Risk rank
Rank I : High Risk
Rank II: Medium Risk
Rank III: Low Risk

Risk evaluation result



Magnitude of fallen rock



The rock fall energy is calculated using the relative height difference between the outcrop where the rock mass is confirmed and the position of the main longitudinal survey line, and the average slope angle.

Size of rock which has 500kJ or more kinetic energy are actual size obtained measured on the site. Those are considered to be broken along the joints during the fall process. Individual removal rock is difficult.

Calculation of kinetic energy of fallen rock

$$E = (1 + \beta) \times (1 - \frac{\mu}{tan\varphi}) \times w \cdot H$$

Guideline on countermeasure for rockfall (Japan Road Association: 2017 rev.)

Where,

E: Kinetic energy (kJ)

β: coefficient of rotational energy (0.1)

μ: coefficient of equivalent friction (Table-1)

φ: angle of slope (degree)

w: weight of rock (kN)

H: height of slope (m)

Table-1

	Condition	μ
A	Hard rock slope, rounded, flatten, no tree	0.05
B	Soft rock slope, rounded-angular, med- undulation, no tree	0.15
C	Soil, Talus deposit, rounded-angular, Low to med- undulation, no tree	0.25
D	Talus deposit with boulder, angular, med-high undulation, no/some trees	0.35

Conclusion

- Rock slope which is source of rockfall shows loosen condition on the surface (t=0.8m).
- The loosen area on rock slope is not whole stretch but are existed partially.
- Kinetic energy of estimated falling rock is around 300kJ.
- Based on rockfall risk evaluation, the slope can be sectioned into 3 categories as High risk, medium risk and low risk of rock fall.
- The area for installation of countermeasure work shall be considered on the risk evaluation result.