

ANEXOS

ANEXO A: RMR

54	71	202		110		1.1		5.1		X		5.1			1						X								7			X	X			X					
55	48	213	30			0.3		3		X		3			1						X								5			X	X			X					
56	46	219		520		5.2		3		X		3			2						X							7			X	X			X						
57	43	218		100		1		3		X		3			2						X							7			X	X			X						
58	36	211		170		1.7		3		X		3	x				1	X			X							7			X	X			X						
59	40	220		160		1.6	1.5			X		1.5			3						X							5			X	X			X						
60	41	200		140		1.4	1.2			X		1.2			3						X							7			X	X			X						
61	48	193		130		1.3	1.5			X		1.5			1						X							7			X	X			X						

ANEXO B: ENSAYO DE COMPRESIÓN UNIAXIAL

UNIVERSIDAD NACIONAL DEL ALTIPLANO PUNO
 ESCUELA PROFESIONAL DE INGENIERIA CIVIL
 LABORATORIO DE MECANICA DE SUELOS



FECHA:

Muestra: I1

PROYECTO: ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO
 MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y
 PROPUESTA DE ESTABILIZACION - PUNO, 2023

ENSAYO DE COMPRESIÓN SIMPLE

MUESTRA:	D1 SUP (cm)	D2 SUP (cm)	D1 MED (cm)	D2 MED (cm)	D1 INF (cm)	D2 INF (cm)	LONGITUD (cm):	PESO DE LA MUESTRA (gr):	ÁREA (cm ²):	VOLUMEN (cm ³):	RELACIÓN L/D	CARGA (kg)	ESFUERZO (kg/cm ²)	ESFUERZO (Mpa)
I1-M1	5.500	5.500	5.500	5.500	5.500	5.500	12.548	792.17	23.76	298.119	2.3	8460	356.1	34.92
I1-M2	5.496	5.498	5.498	5.498	5.498	5.498	13.362	837.09	23.74	317.189	2.4	8140	342.9	33.63
I1-M3	5.500	5.502	5.500	5.500	5.500	5.498	13.192	828.98	23.76	313.419	2.4	9400	395.7	38.80
NUMERO DE RESULTADOS													3	
VALOR MÁXIMO													38.80	
VALOR MÍNIMO													33.63	
MEDIANA													34.92	
VALOR PROMEDIO													35.78	
DESVIACIÓN ESTANDAR													2.69	
COEFICIENTE DE VARIACIÓN													7.52	

UNIVERSIDAD NACIONAL DEL ALTIPLANO PUNO
 ESCUELA PROFESIONAL DE INGENIERIA CIVIL
 LABORATORIO DE MECANICA DE SUELOS



FECHA: 27/10/2023

Muestra: I2

PROYECTO: ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ENSAYO DE COMPRESIÓN SIMPLE

MUESTRA:	D1 SUP (cm)	D2 SUP (cm)	D1 MED (cm)	D2 MED (cm)	D1 INF (cm)	D2 INF (cm)	LONGITUD (cm):	PESO DE LA MUESTRA (gr):	ÁREA (cm ²):	VOLUMEN (cm ³):	RELACIÓN L/D	CARGA (kg)	ESFUERZO (kg/cm ²)	ESFUERZO (Mpa)
I2-M1	5.500	5.500	5.500	5.500	5.498	5.498	13.198	775.75	23.75	313.486	2.4	5580	234.9	23.04
I2-M2	5.498	5.496	5.498	5.498	5.500	5.498	12.932	803.58	23.74	307.019	2.4	9320	392.6	38.50
I2-M3	5.500	5.500	5.500	5.500	5.500	5.500	13.196	813.40	23.76	313.514	2.4	8270	348.1	34.14
NUMERO DE RESULTADOS														3
VALOR MÁXIMO														38.50
VALOR MÍNIMO														23.04
MEDIANA														34.14
VALOR PROMEDIO														31.89
DESVIACIÓN ESTANDAR														7.97
COEFICIENTE DE VARIACIÓN														24.99

UNIVERSIDAD NACIONAL DEL ALTIPLANO PUNO
 ESCUELA PROFESIONAL DE INGENIERIA CIVIL
 LABORATORIO DE MECANICA DE SUELOS



FECHA: 27/10/2023

Muestra: I3

PROYECTO: ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ENSAYO DE COMPRESIÓN SIMPLE

MUESTRA:	D1 SUP (cm)	D2 SUP (cm)	D1 MED (cm)	D2 MED (cm)	D1 INF (cm)	D2 INF (cm)	LONGITUD (cm):	PESO DE LA MUESTRA (gr):	ÁREA (cm ²):	VOLUMEN (cm ³):	RELACIÓN L/D	CARGA (kg)	ESFUERZO (kg/cm ²)	ESFUERZO (Mpa)
I3-M1	5.498	5.500	5.500	5.498	5.500	5.500	11.522	705.800	23.75	273.677	2.1	5550	233.7	22.91
I3-M2	5.500	5.498	5.500	5.500	5.500	5.500	11.962	729.350	23.76	284.162	2.2	7310	307.7	30.18
I3-M3	5.500	5.498	5.498	5.498	5.500	5.198	11.660	714.510	23.32	271.875	2.1	5620	241.0	23.64
NUMERO DE RESULTADOS														3
VALOR MÁXIMO														30.18
VALOR MÍNIMO														22.91
MEDIANA														23.64
VALOR PROMEDIO														25.58
DESVIACIÓN ESTANDAR														4.00
COEFICIENTE DE VARIACIÓN														15.64

ANEXO B': ENSAYO DE PROPIEDADES FÍSICAS



FECHA: 10/10/2023

PROYECTO: ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ENSAYO DE PROPIEDADES FISICAS DE LA ROCA

MUESTRA:	MASA DE LA ROCA SECA (Wsec)	MASA DE LA ROCA SATURADA (Wsat)	MASA DE LA ROCA SUMERGIDA (Wsum)	VOLUMEN DE AGUA DESPLAZADO m ³	DENSIDAD DE LA ROCA SECA	DENSIDAD DE LA ROCA SATURADA	GRAVEDAD ESPECIFICA DE LA ROCA SECA	GRAVEDAD ESPECIFICA DE LA ROCA SATURADA	POROSIDAD (n) %	ABSORCIÓN ((Wsat-Wsec)/Wsat) *100 %
P-1	226.55	226.72	140	0.086723	2612.33	2614.29	2.57	2.57	0.00	0.07
P-2	204.04	206.11	124	0.0802	2544.13	2569.94	2.50	2.53	0.03	1.00
P-3	133.21	135.77	79	0.054319	2452.38	2499.51	2.41	2.46	0.05	1.89
P-4	175.04	175.39	102	0.073186	2391.70	2396.48	2.35	2.36	0.005	0.20
P-5	167.41	168.17	100	0.067545	2478.49	2489.74	2.44	2.45	0.01	0.45

ANEXO C: ENSAYO DE TILT TEST



PROYECTO: ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ENSAYO DE TILT TEST

Muestra:	Diametro:	Longitud:	Relación:	Phi básico:	R	r	Phi residual:
I1-M1	5.5	12.55	2.3	42.4	23.2	21.4	40.85
I1-M2	5.5	13.36	2.4	43.5	23.2	21.4	41.95
I1-M3	5.5	13.19	2.4	41.5	23.2	21.4	39.95
NUMERO DE RESULTADOS							3
VALOR MÁXIMO							41.95
VALOR MÍNIMO							39.95
MEDIANA							40.85
VALOR PROMEDIO							40.91
DESVIACIÓN ESTANDAR							1.00
COEFICIENTE DE VARIACIÓN							2.45

I2-M1	5.5	13.2	2.4	46.8	21.6	18.6	44.02
I2-M2	5.5	12.93	2.4	44.5	21.6	18.6	41.72
I2-M3	5.5	13.2	2.4	43.2	22.5	18.6	39.73
NUMERO DE RESULTADOS							3
VALOR MÁXIMO							44.02
VALOR MÍNIMO							39.73
MEDIANA							41.72
VALOR PROMEDIO							41.83
DESVIACIÓN ESTANDAR							2.15
COEFICIENTE DE VARIACIÓN							5.13

I3-M1	5.5	11.52	2.1	38.4	22.2	20.2	36.6
I3-M2	5.5	11.96	2.2	43.2	22.2	20.2	41.4
I3-M3	5.5	11.66	2.1	40	22.2	20.2	38.2
NUMERO DE RESULTADOS							3
VALOR MÁXIMO							41.40
VALOR MÍNIMO							36.60
MEDIANA							38.20
VALOR PROMEDIO							38.73
DESVIACIÓN ESTANDAR							2.44
COEFICIENTE DE VARIACIÓN							6.31



**CONSTANCIA DE USO DE EQUIPOS DE LABORATORIO
DE MECÁNICA DE SUELOS Y MATERIALES**

**EL QUE SUSCRIBE JEFE DE LABORATORIO DE MECÁNICA DE
SUELOS Y MATERIALES DE LA FICA**

Hace constar:

Que el tesista, **Bach. MARCELO JOSE CUENTAS MERCADO**, hizo uso de los equipos del Laboratorio de Mecánica de Suelos y Materiales - FICA, para realizar los ensayos requeridos para su proyecto de Tesis: "**ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL MÉTODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023**". Conducente a la obtención del Título profesional de Ingeniero Civil.

Los ensayos que realizaron son los siguientes:

ENSAYOS DE LABORATORIO REALIZADOS

ÍTEM	ENSAYOS	NORMA	U.M.	CANTIDAD
01	Densidad por reemplazo de agua en Suelos Granulares (Mat. >3")	ASTM D-5030	Und.	01
02	Propiedades Físicas de Roca (humedad, densidad, porosidad, absorción).	ASTMD-6473	Und.	03
03	Ensayo de Resistencia a la Compresión Inconfinada de Núcleo de Roca (min 3 núcleos perforados).	ASTM D-2938	Und.	03
04	Ensayo Tilt Test de rocas en Laboratorio.	ISMR	Und.	03

Los resultados obtenidos, de los ensayos, no son responsabilidad del Laboratorio de Mecánica de Suelos y Materiales.

Se le expide la presente constancia a solicitud escrita del interesado, para adjuntar en su proyecto de Tesis.

Puno, C. U. 06 de diciembre del 2023.



C.c.
Arch./LMSYM

**ANEXO D: CRITERIO DE RESISTENCIA DEL MACIZO
ROCOSO**

Analysis of Rock/Soil Strength using RocData

Hoek-Brown Classification

intact uniaxial comp. strength (σ_{ci}) = 31.89 MPa
GSI = 43 m_i = 12 Disturbance factor = 1
intact modulus (E_i) = 410000 MPa

Hoek-Brown Criterion

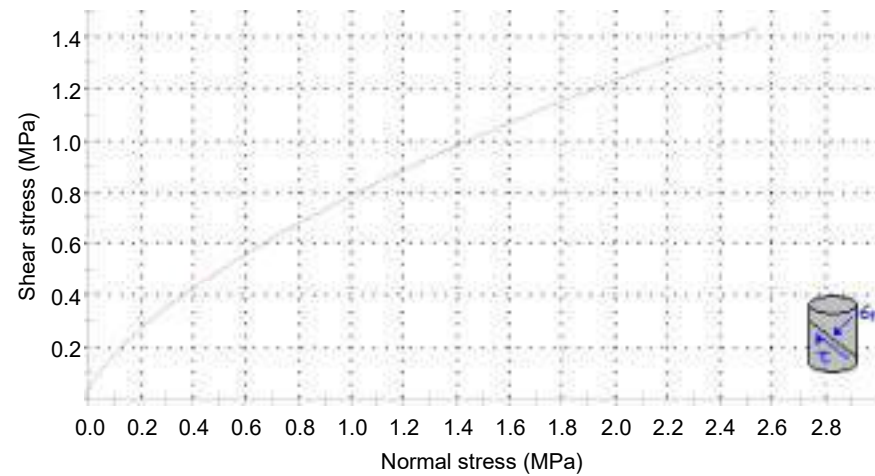
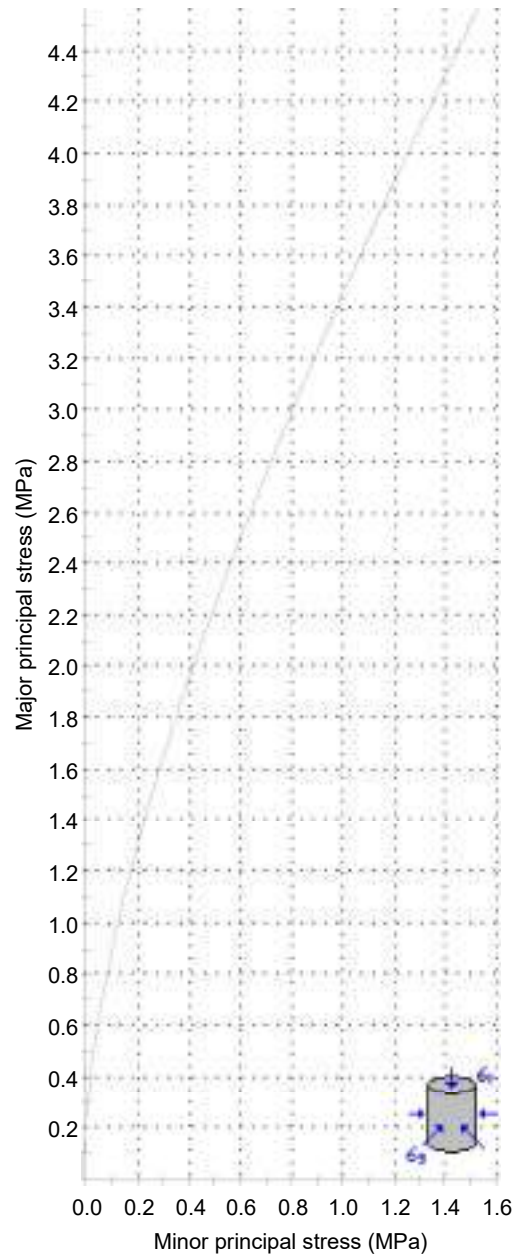
m_b = 0.205 s = 0.0001 a = 0.509

Mohr-Coulomb Fit

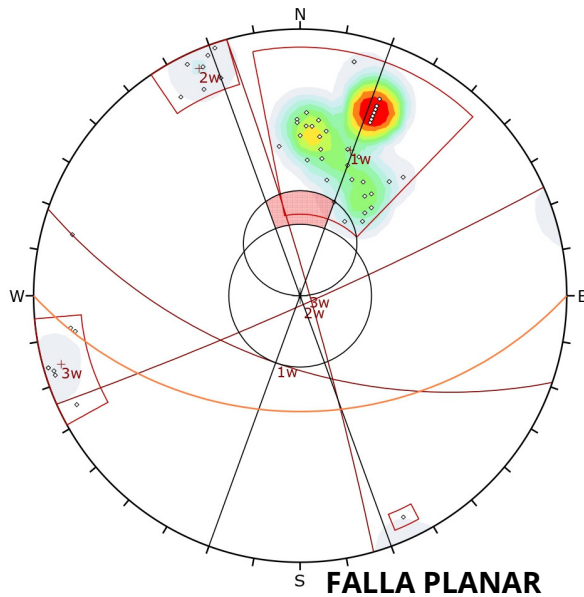
cohesion = 0.250 MPa friction angle = 26.31 deg

Rock Mass Parameters

tensile strength = -0.012 MPa
uniaxial compressive strength = 0.253 MPa
global strength = 1.828 MPa
modulus of deformation = 18799.73 MPa



ANEXO E: ANALISIS ESTEREOGRÁFICO



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

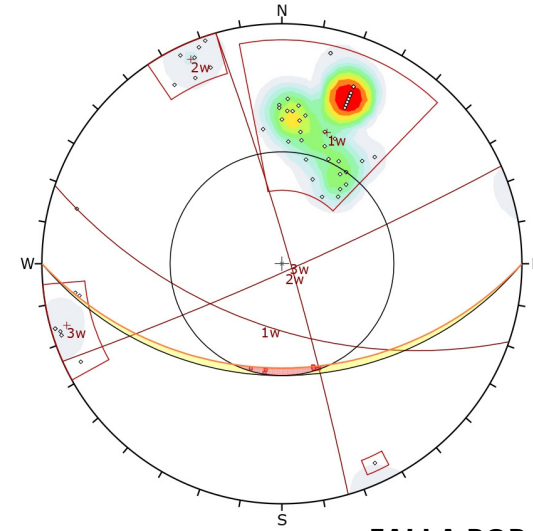
Contour Data	Pole Vectors
Maximum Density	23.88%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	43
Slope Dip Direction	180
Friction Angle	30°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Planar Sliding (All)	4	156	2.48%
Planar Sliding (Set 1)	4	137	2.82%

Plot Mode	Pole Vectors
Vector Count (Weighted)	156 (61 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

FALLA PLANAR



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

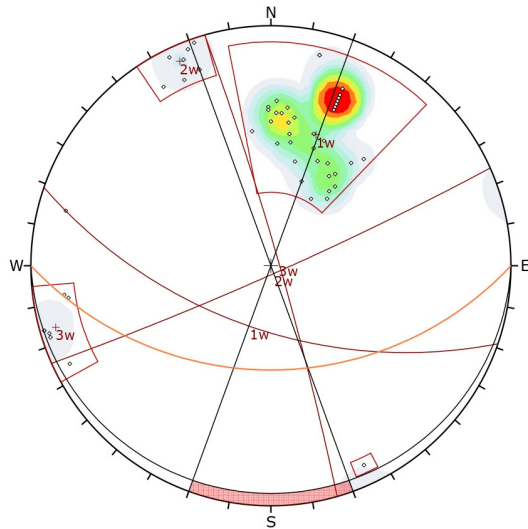
Contour Data	Pole Vectors
Maximum Density	23.88%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	43
Slope Dip Direction	180
Friction Angle	40°

Weighted Results	Critical	Total	%
Wedge Sliding	62	11836	0.52%

Plot Mode	Pole Vectors
Vector Count (Weighted)	156 (61 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	11836
Hemisphere	Lower
Projection	Equal Angle

FALLA POR CUÑA



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

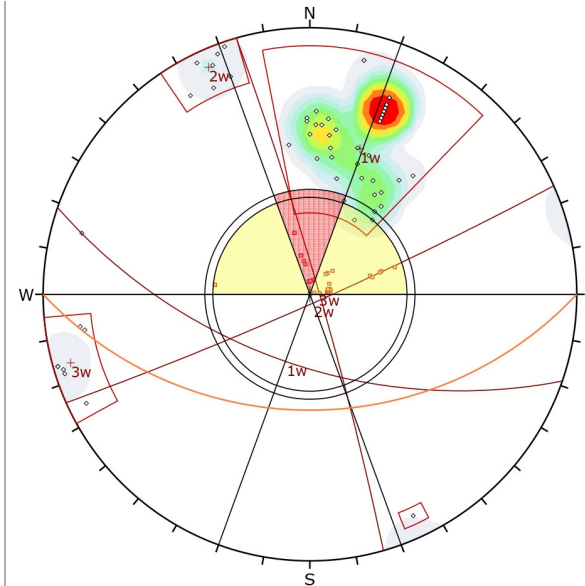
Contour Data	Pole Vectors
Maximum Density	23.88%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Topping
Slope Dip	43
Slope Dip Direction	180
Friction Angle	40°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Flexural Topping (All)	0	156	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	156 (61 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

FALLA POR VUELCO FLEXURAL



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

Contour Data	Pole Vectors
Maximum Density	23.88%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Topping
Slope Dip	43
Slope Dip Direction	180
Friction Angle	40°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Direct Topping (Intersection)	14	11836	0.12%
Oblique Topping (Intersection)	44	11836	0.38%
Base Plane (All)	11	156	7.00%
Base Plane (Set 1)	11	137	7.95%

Plot Mode	Pole Vectors
Vector Count (Weighted)	156 (61 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	11836
Hemisphere	Lower
Projection	Equal Angle

FALLA POR VUELCO DIRECTO



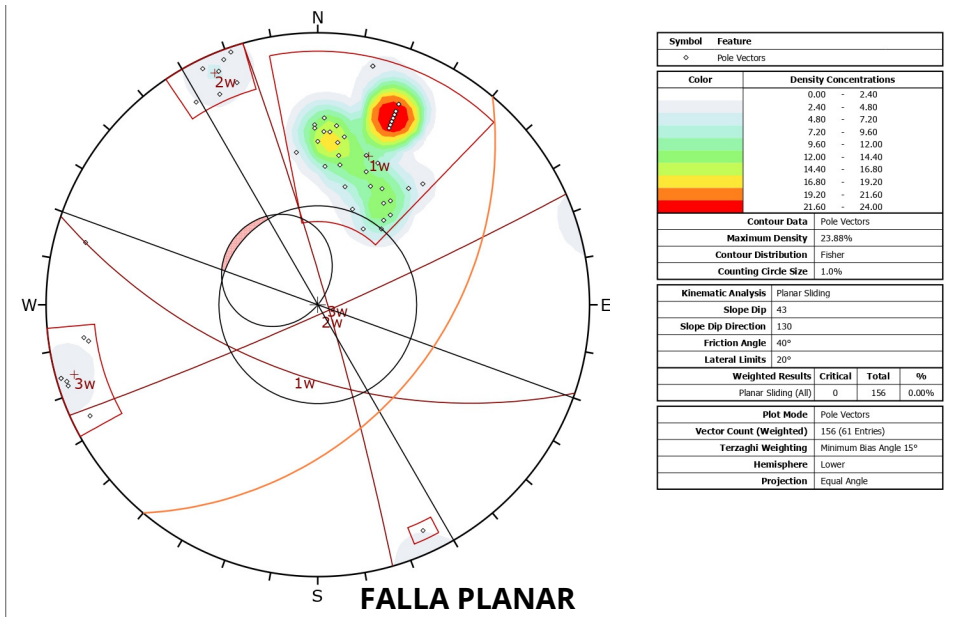
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

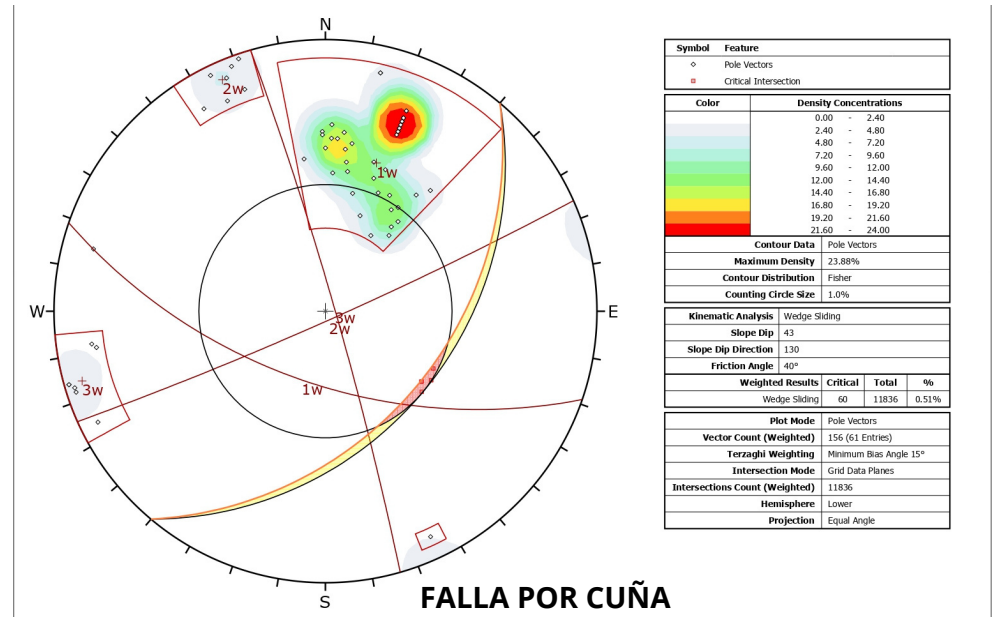
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BACHILLER: MARCELO JOSE CUENTAS MERCADO

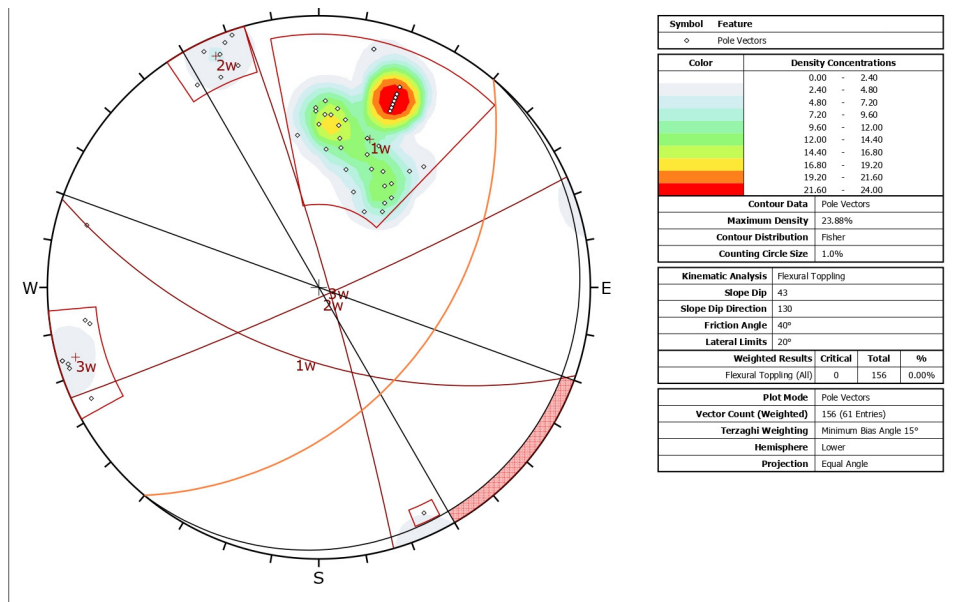
FECHA: DICIEMBRE 2023



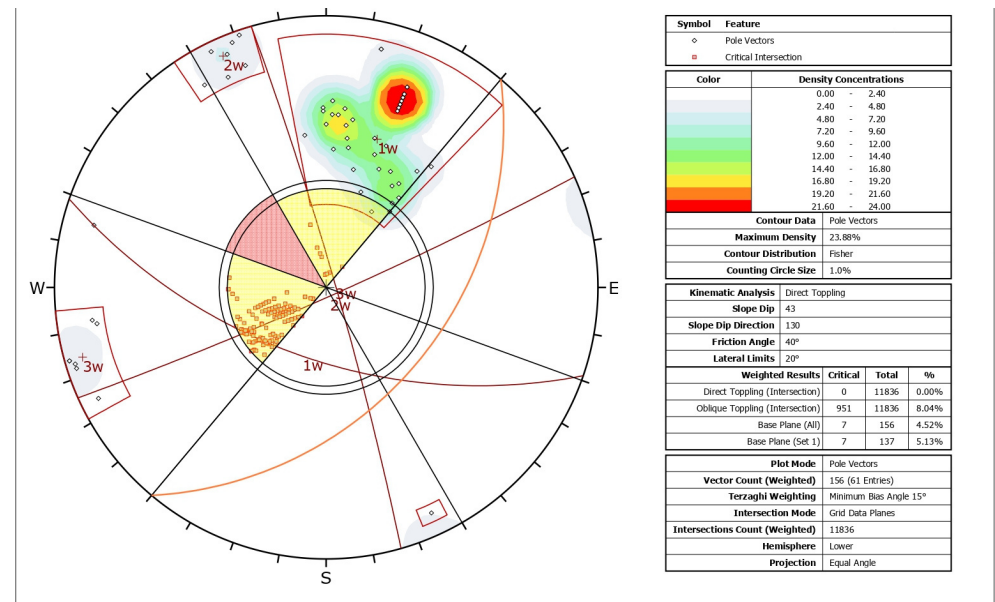
FALLA PLANAR



FALLA POR CUÑA

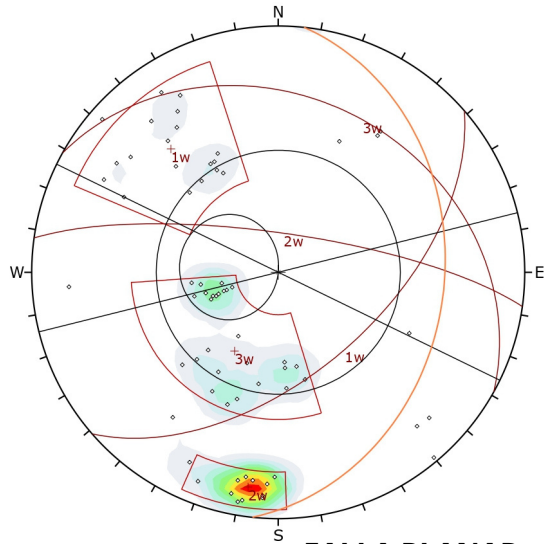


FALLA POR VUELCO FLEXURAL



FALLA POR VUELCO DIRECTO

	ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023	
	ANÁLISIS DE ESTABILIDAD CINEMÁTICO	TALUD: S-02
	BACHILLER: MARCELO JOSE CUENTAS MERCADO	FECHA: DICIEMBRE 2023



Symbol	Feature
○	Pole Vectors
■	Critical Interaction

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

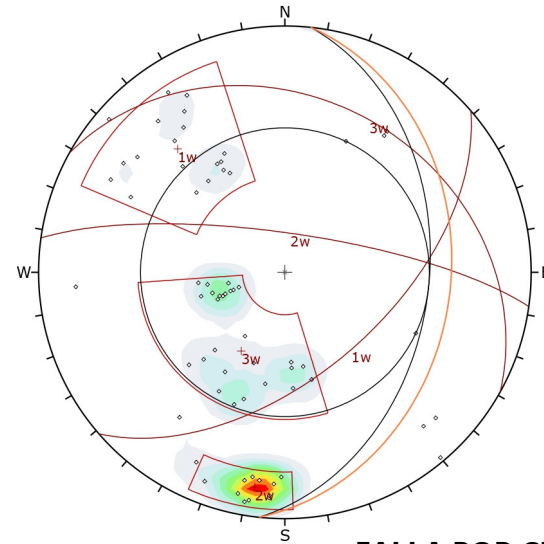
Contour Data		Pole Vectors
Maximum Density	23.40%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

Kinematic Analysis		Planar Sliding
Slope Dip	33	
Slope Dip Direction	96	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Planar Sliding (All)	0	119	0.00%

Plot Mode		Pole Vectors
Vector Count (Weighted)	119 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Hemisphere	Lower	
Projection	Equal Area	

FALLA PLANAR



Symbol	Feature
○	Pole Vectors
■	Critical Interaction

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

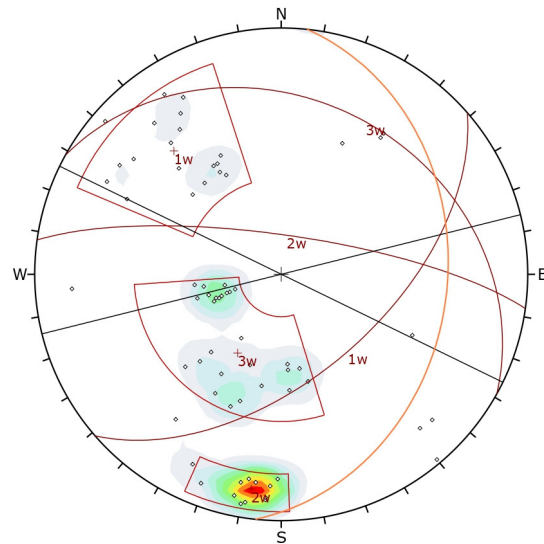
Contour Data		Pole Vectors
Maximum Density	23.40%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

Kinematic Analysis		Wedge Sliding
Slope Dip	33	
Slope Dip Direction	96	
Friction Angle	41°	

Weighted Results	Critical	Total	%
Wedge Sliding	0	6892	0.00%

Plot Mode		Pole Vectors
Vector Count (Weighted)	119 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Intersection Mode	Grid Data Planes	
Intersections Count (Weighted)	6892	
Hemisphere	Lower	
Projection	Equal Area	

FALLA POR CUÑA



Symbol	Feature
○	Pole Vectors
■	Critical Interaction

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

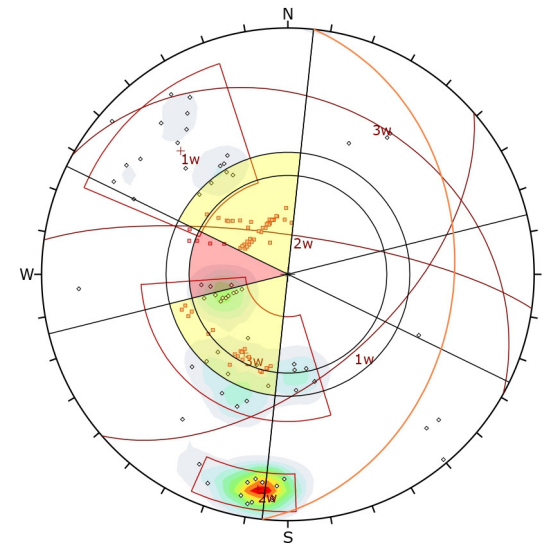
Contour Data		Pole Vectors
Maximum Density	23.40%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

Kinematic Analysis		Flexural Topping
Slope Dip	33	
Slope Dip Direction	96	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Flexural Topping (All)	0	119	0.00%

Plot Mode		Pole Vectors
Vector Count (Weighted)	119 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Hemisphere	Lower	
Projection	Equal Area	

FALLA POR VUELCO FLEXURAL



Symbol	Feature
○	Pole Vectors
■	Critical Interaction

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

Contour Data		Pole Vectors
Maximum Density	23.40%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

Kinematic Analysis		Direct Topping
Slope Dip	33	
Slope Dip Direction	96	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Direct Topping (Intersection)	25	6892	0.36%
Oblique Topping (Intersection)	297	6892	4.31%
Base Plane (All)	30	119	25.54%
Base Plane (Set 1)	4	19	21.44%
Base Plane (Set 3)	26	47	55.70%

Plot Mode		Pole Vectors
Vector Count (Weighted)	119 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Intersection Mode	Grid Data Planes	
Intersections Count (Weighted)	6892	
Hemisphere	Lower	
Projection	Equal Area	

FALLA POR VUELCO DIRECTO



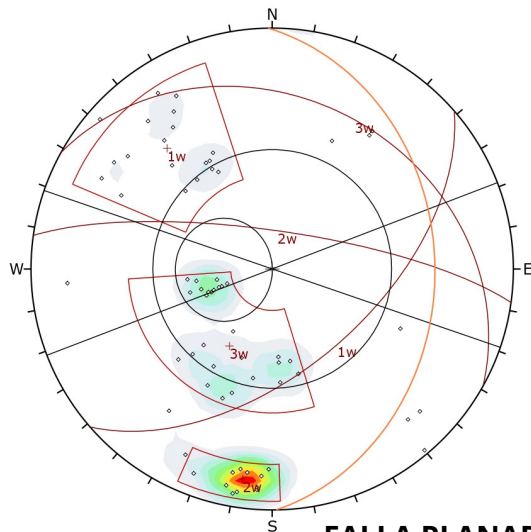
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-03

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

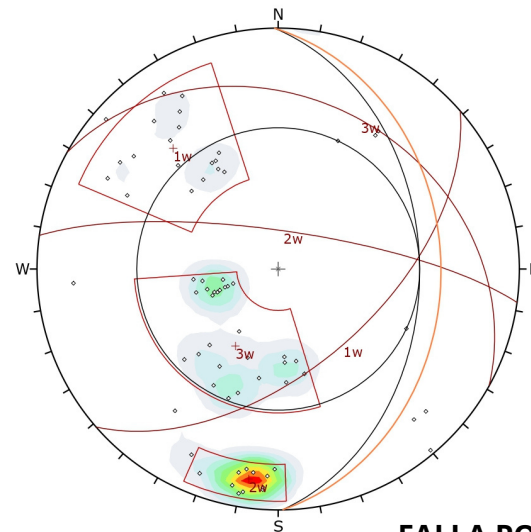
Contour Data	Pole Vectors
Maximum Density	23.40%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	33
Slope Dip Direction	89
Friction Angle	41°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Planar Sliding (A1)	0	119	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	119 (67 Entries)
Terzaghi Weighting	Minimum Bas Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA PLANAR



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

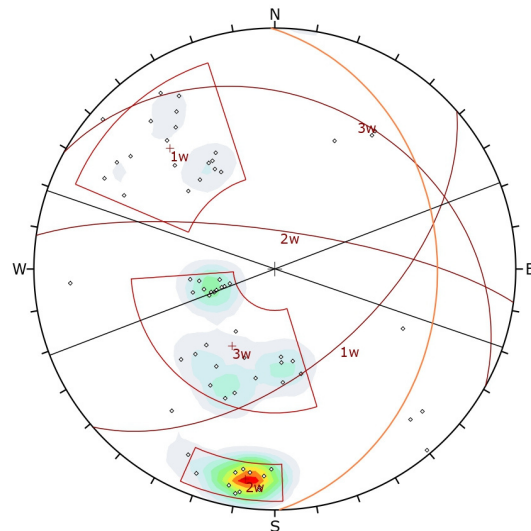
Contour Data	Pole Vectors
Maximum Density	23.40%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	33
Slope Dip Direction	89
Friction Angle	41°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Wedge Sliding	0	6892	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	119 (67 Entries)
Terzaghi Weighting	Minimum Bas Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	6892
Hemisphere	Lower
Projection	Equal Area

FALLA POR CUÑA



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

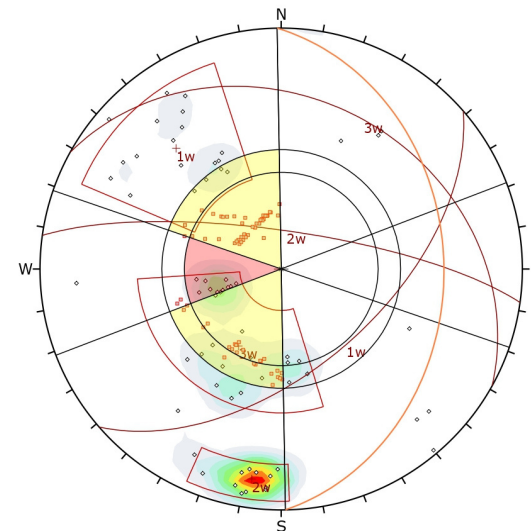
Contour Data	Pole Vectors
Maximum Density	23.40%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Topping
Slope Dip	33
Slope Dip Direction	89
Friction Angle	41°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Flexural Topping (A1)	0	119	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	119 (67 Entries)
Terzaghi Weighting	Minimum Bas Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA POR VUELCO FLEXURAL



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00	- 2.40
2.40	- 4.80
4.80	- 7.20
7.20	- 9.60
9.60	- 12.00
12.00	- 14.40
14.40	- 16.80
16.80	- 19.20
19.20	- 21.60
21.60	- 24.00

Contour Data	Pole Vectors
Maximum Density	23.40%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Topping
Slope Dip	33
Slope Dip Direction	89
Friction Angle	41°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Direct Topping (Intersection)	0	6892	0.00%
Oblique Topping (Intersection)	318	6892	4.61%
Base Plane (A1)	30	119	25.54%
Base Plane (Set 1)	4	19	21.44%
Base Plane (Set 3)	26	47	55.70%

Plot Mode	Pole Vectors
Vector Count (Weighted)	119 (67 Entries)
Terzaghi Weighting	Minimum Bas Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	6892
Hemisphere	Lower
Projection	Equal Area

FALLA POR VUELCO DIRECTO



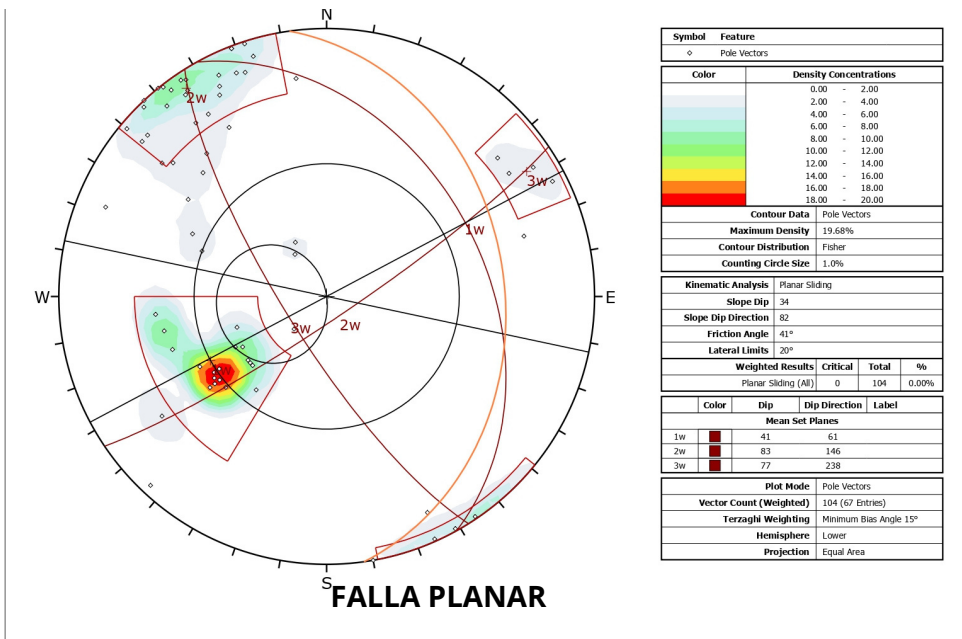
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

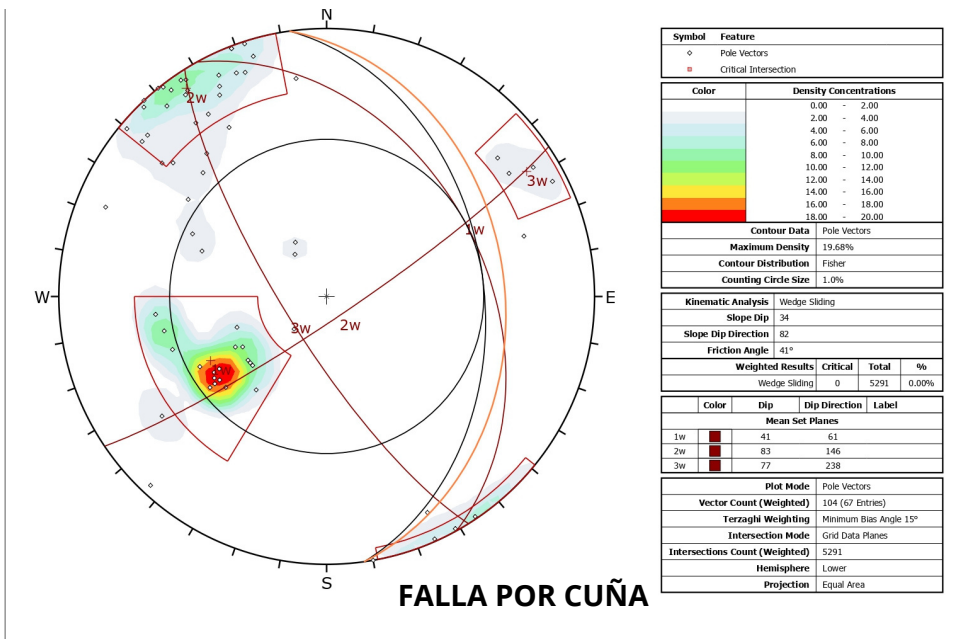
TALUD: S-04

BACHILLER: MARCELO JOSE CUENTAS MERCADO

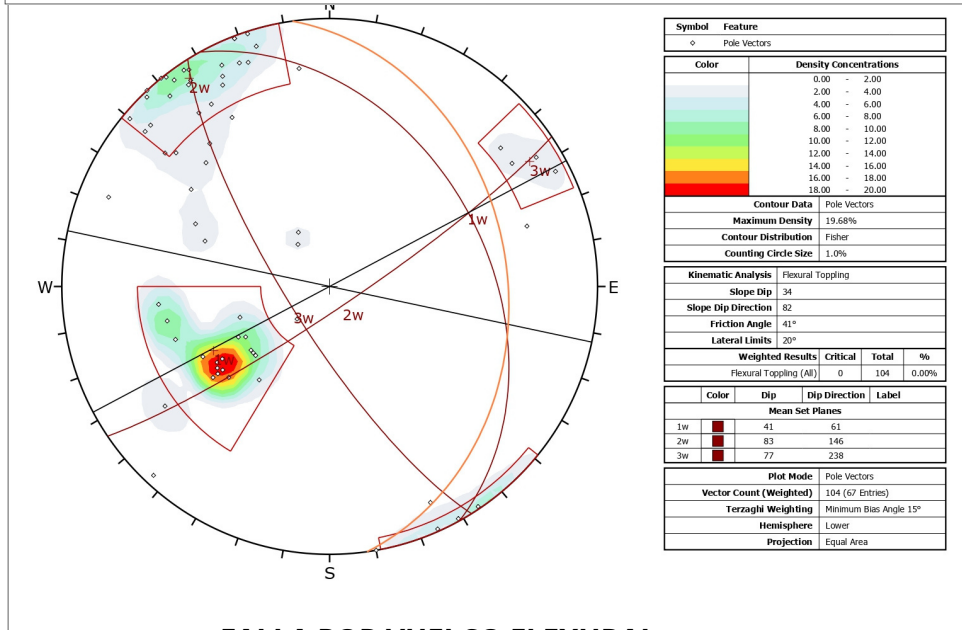
FECHA: DICIEMBRE 2023



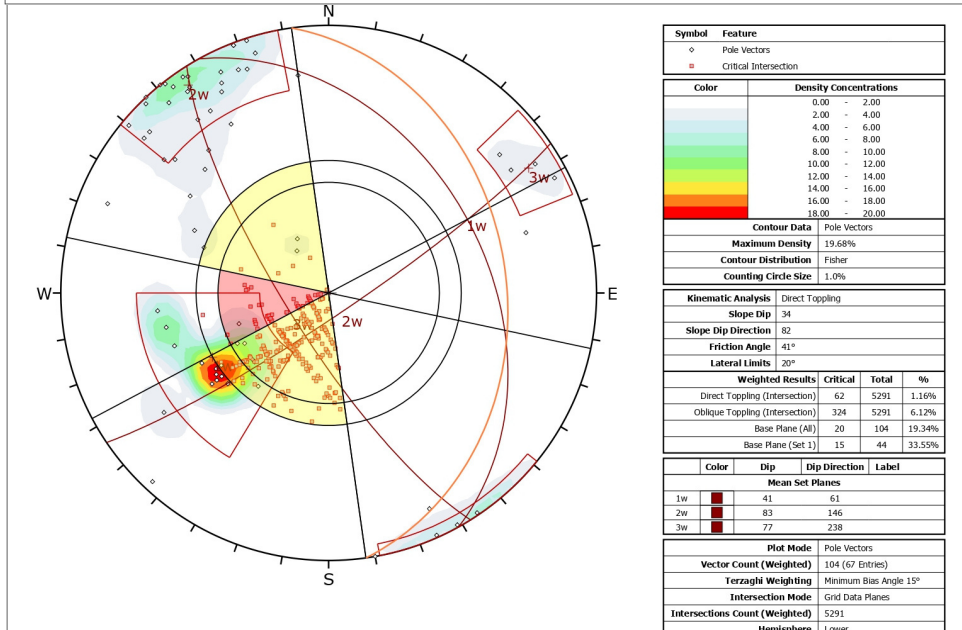
FALLA PLANAR



FALLA POR CUÑA



FALLA POR VUELCO FLEXURAL



FALLA POR VUELCO DIRECTO



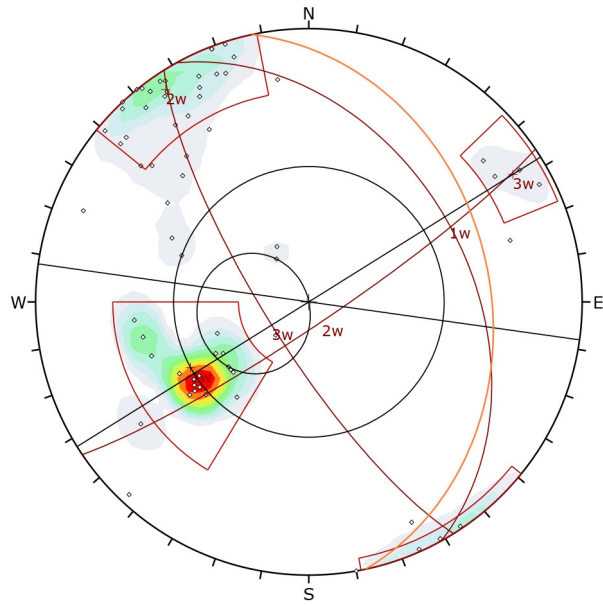
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-05

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
Light Blue	0.00 - 2.00
Blue	2.00 - 4.00
Green	4.00 - 6.00
Yellow	6.00 - 8.00
Orange	8.00 - 10.00
Red-Orange	10.00 - 12.00
Red	12.00 - 14.00
Dark Red	14.00 - 16.00
Black	16.00 - 18.00
Black	18.00 - 20.00

Contour Data		Pole Vectors
Maximum Density	19.68%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

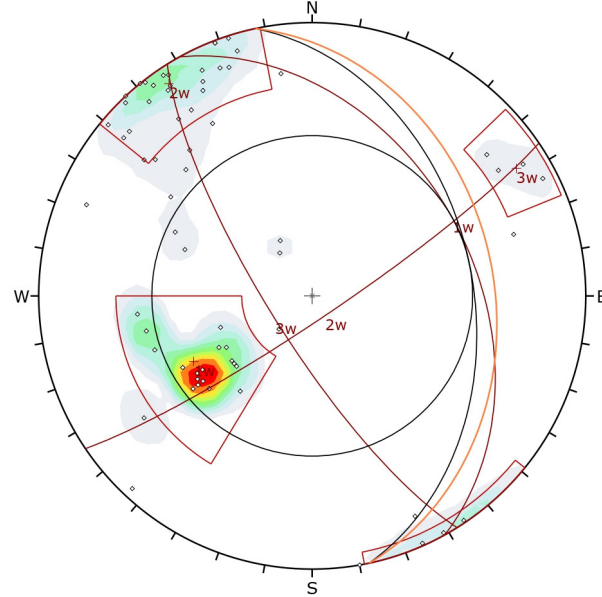
Kinematic Analysis		Planar Sliding
Slope Dip	34	
Slope Dip Direction	78	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Planar Sliding (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA PLANAR



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
Light Blue	0.00 - 2.00
Blue	2.00 - 4.00
Green	4.00 - 6.00
Yellow	6.00 - 8.00
Orange	8.00 - 10.00
Red-Orange	10.00 - 12.00
Red	12.00 - 14.00
Dark Red	14.00 - 16.00
Black	16.00 - 18.00
Black	18.00 - 20.00

Contour Data		Pole Vectors
Maximum Density	19.68%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

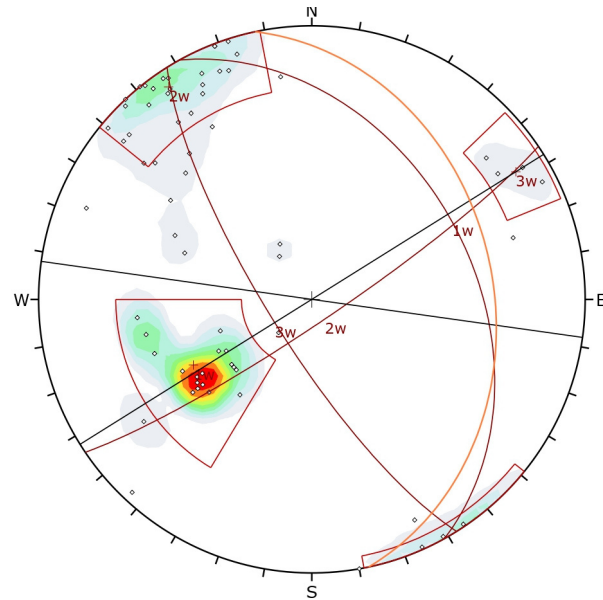
Kinematic Analysis		Wedge Sliding
Slope Dip	34	
Slope Dip Direction	78	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Wedge Sliding (All)	0	5291	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors	
Vector Count (Weighted)	104 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Intersection Mode	Grid Data Planes	
Intersections Count (Weighted)	5291	
Hemisphere	Lower	
Projection	Equal Area	

FALLA POR CUÑA



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
Light Blue	0.00 - 2.00
Blue	2.00 - 4.00
Green	4.00 - 6.00
Yellow	6.00 - 8.00
Orange	8.00 - 10.00
Red-Orange	10.00 - 12.00
Red	12.00 - 14.00
Dark Red	14.00 - 16.00
Black	16.00 - 18.00
Black	18.00 - 20.00

Contour Data		Pole Vectors
Maximum Density	19.68%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

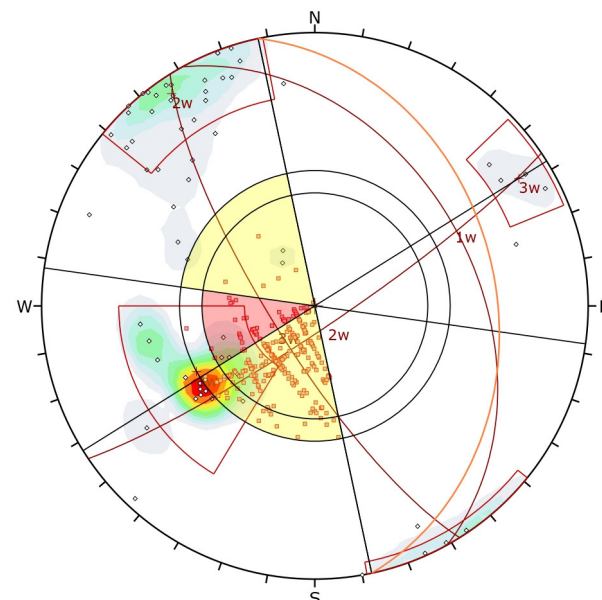
Kinematic Analysis		Flexural Toppling
Slope Dip	34	
Slope Dip Direction	78	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Flexural Toppling (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA POR VUELCO FLEXURAL



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
Light Blue	0.00 - 2.00
Blue	2.00 - 4.00
Green	4.00 - 6.00
Yellow	6.00 - 8.00
Orange	8.00 - 10.00
Red-Orange	10.00 - 12.00
Red	12.00 - 14.00
Dark Red	14.00 - 16.00
Black	16.00 - 18.00
Black	18.00 - 20.00

Contour Data		Pole Vectors
Maximum Density	19.68%	
Contour Distribution	Fisher	
Counting Circle Size	1.0%	

Kinematic Analysis		Direct Toppling
Slope Dip	34	
Slope Dip Direction	78	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Direct Toppling (Intersection)	72	5291	1.36%
Oblique Toppling (Intersection)	328	5291	6.20%
Base Plane (All)	20	104	19.34%
Base Plane (Set 1)	15	44	33.55%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors	
Vector Count (Weighted)	104 (67 Entries)	
Terzaghi Weighting	Minimum Bias Angle 15°	
Intersection Mode	Grid Data Planes	
Intersections Count (Weighted)	5291	
Hemisphere	Lower	
Projection	Equal Area	

FALLA POR VUELCO DIRECTO



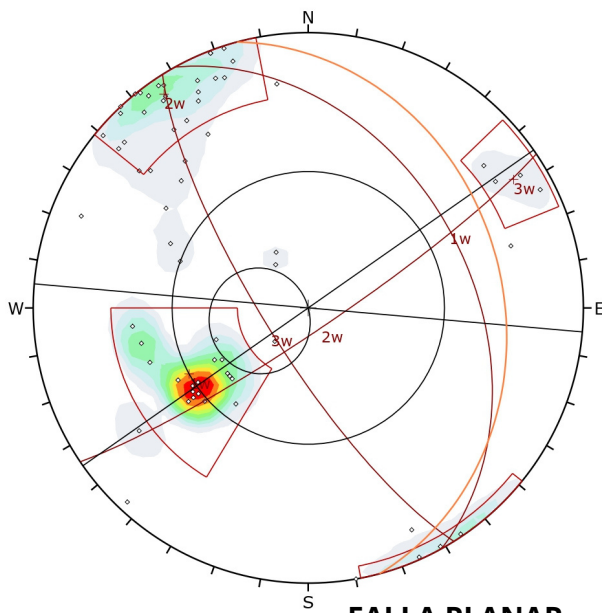
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-06

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



FALLA PLANAR

Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

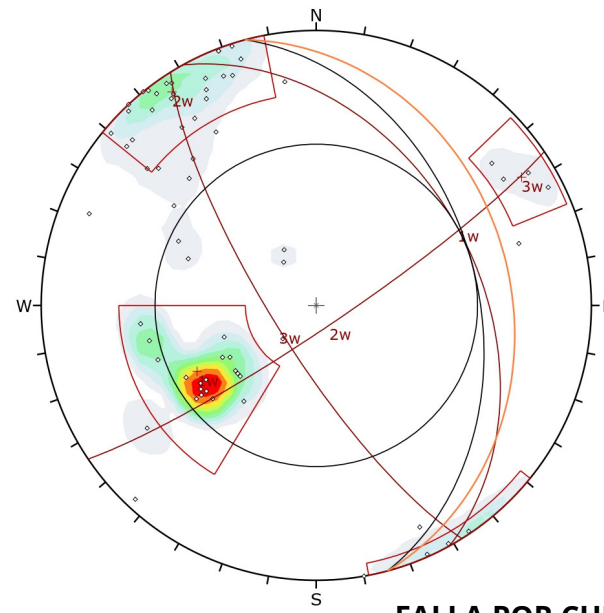
Kinematic Analysis		Planar Sliding
Slope Dip	30	
Slope Dip Direction	75	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results			
	Critical	Total	%
Planar Sliding (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Mean Set Planes	
1w	41 61
2w	83 146
3w	77 238

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area



FALLA POR CUÑA

Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

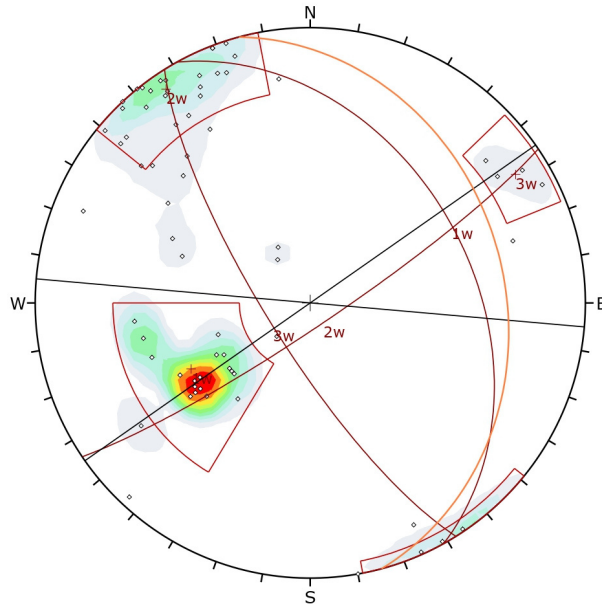
Kinematic Analysis		Wedge Sliding
Slope Dip	30	
Slope Dip Direction	75	
Friction Angle	41°	

Weighted Results			
	Critical	Total	%
Wedge Sliding (All)	0	5291	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Mean Set Planes	
1w	41 61
2w	83 146
3w	77 238

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	5291
Hemisphere	Lower
Projection	Equal Area



FALLA POR VUELCO FLEXURAL

Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

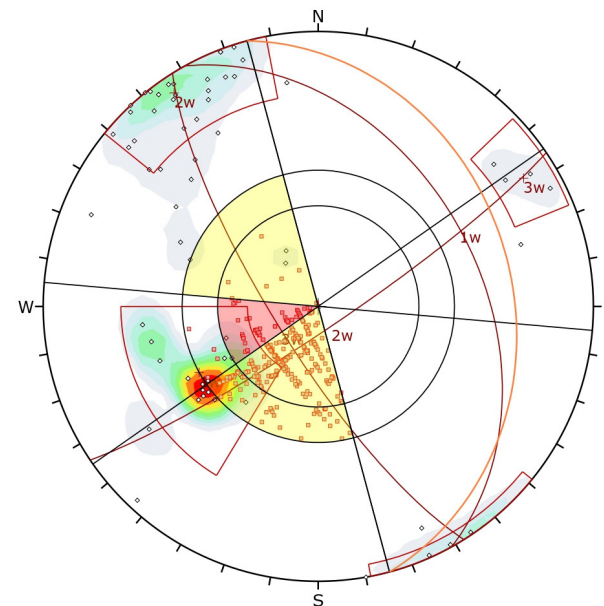
Kinematic Analysis		Flexural Toppling
Slope Dip	30	
Slope Dip Direction	75	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results			
	Critical	Total	%
Flexural Toppling (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Mean Set Planes	
1w	41 61
2w	83 146
3w	77 238

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area



FALLA POR VUELCO DIRECTO

Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis		Direct Toppling
Slope Dip	30	
Slope Dip Direction	75	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results			
	Critical	Total	%
Direct Toppling (Intersection)	69	5291	1.30%
Oblique Toppling (Intersection)	342	5291	6.46%
Base Plane (All)	20	104	19.34%
Base Plane (Set 1)	15	44	33.55%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Mean Set Planes	
1w	41 61
2w	83 146
3w	77 238

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	5291



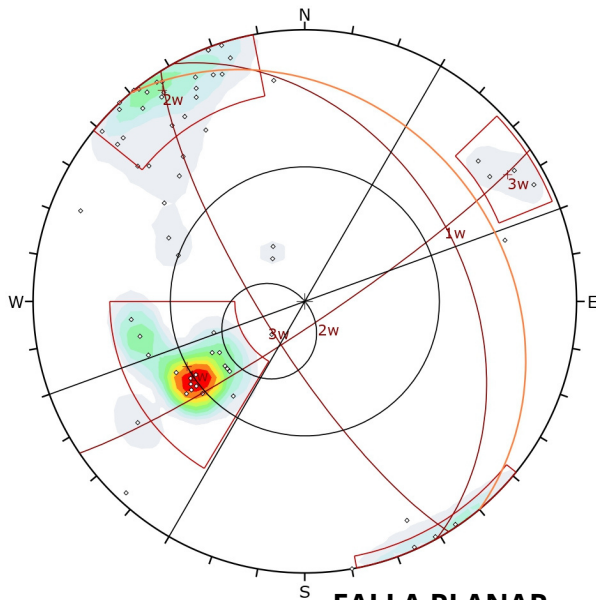
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-07

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

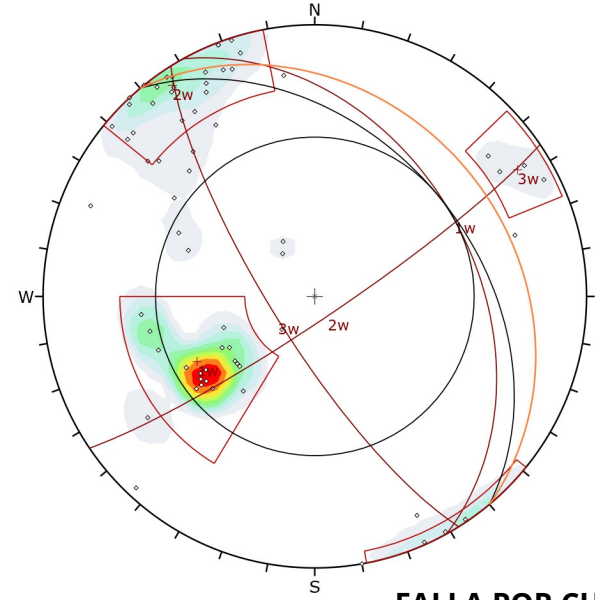
Kinematic Analysis		Planar Sliding
Slope Dip	28	
Slope Dip Direction	50	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Planar Sliding (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA PLANAR



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

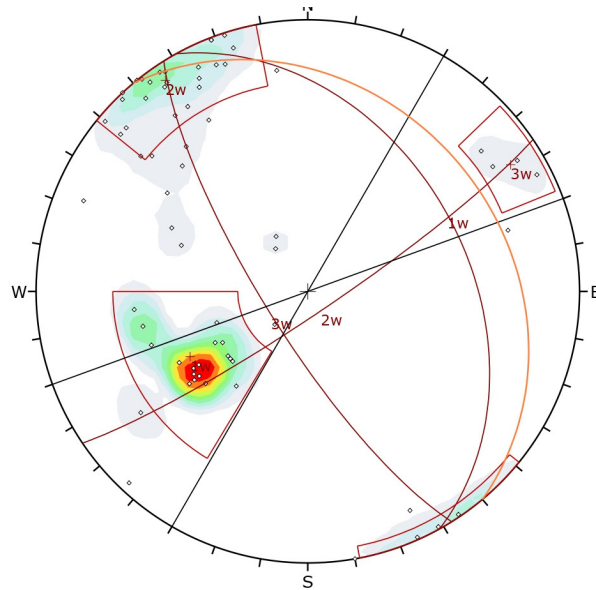
Kinematic Analysis		Wedge Sliding
Slope Dip	28	
Slope Dip Direction	50	
Friction Angle	41°	

Weighted Results	Critical	Total	%
Wedge Sliding	0	5291	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	5291
Hemisphere	Lower
Projection	Equal Area

FALLA POR CUÑA



Symbol	Feature
○	Pole Vectors

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

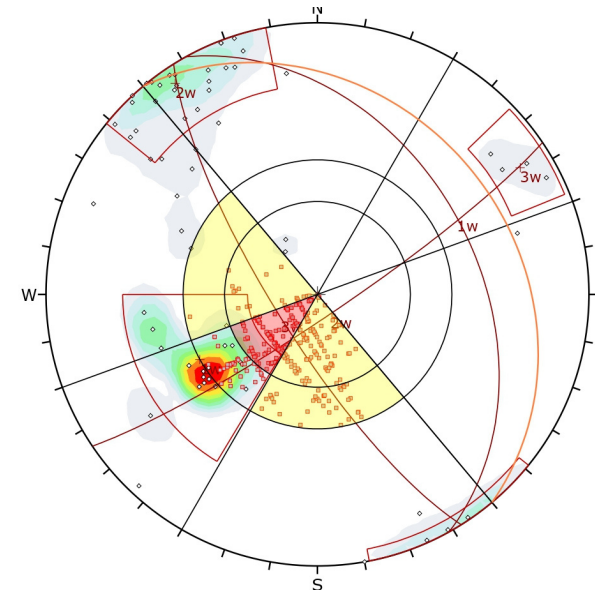
Kinematic Analysis		Flexural Toppling
Slope Dip	28	
Slope Dip Direction	50	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Flexural Toppling (All)	0	104	0.00%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Area

FALLA POR VUELCO FLEXURAL



Symbol	Feature
○	Pole Vectors
■	Critical Intersection

Color	Density Concentrations
0.00 - 2.00	
2.00 - 4.00	
4.00 - 6.00	
6.00 - 8.00	
8.00 - 10.00	
10.00 - 12.00	
12.00 - 14.00	
14.00 - 16.00	
16.00 - 18.00	
18.00 - 20.00	

Contour Data	Pole Vectors
Maximum Density	19.68%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis		Direct Toppling
Slope Dip	28	
Slope Dip Direction	50	
Friction Angle	41°	
Lateral Limits	20°	

Weighted Results	Critical	Total	%
Direct Toppling (Intersection)	165	5291	3.12%
Oblique Toppling (Intersection)	274	5291	5.17%
Base Plane (All)	18	104	17.34%
Base Plane (Set 1)	15	44	33.55%

Color	Dip	Dip Direction	Label
1w	41	61	
2w	83	146	
3w	77	238	

Plot Mode	Pole Vectors
Vector Count (Weighted)	104 (67 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	5291
Hemisphere	Lower

FALLA POR VUELCO DIRECTO



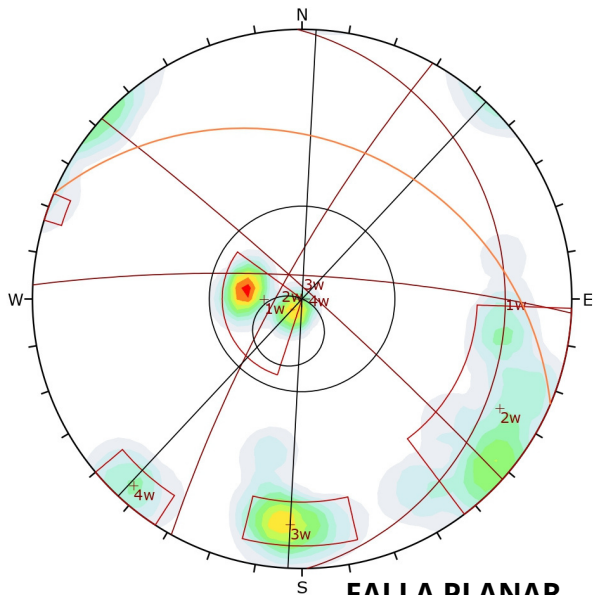
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-08

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



Color	Density Concentrations
0.00 - 1.50	
1.50 - 3.00	
3.00 - 4.50	
4.50 - 6.00	
6.00 - 7.50	
7.50 - 9.00	
9.00 - 10.50	
10.50 - 12.00	
12.00 - 13.50	
13.50 - 15.00	

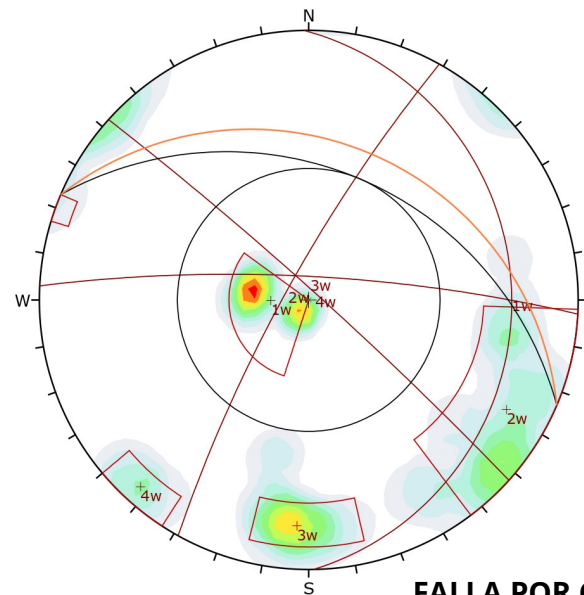
Contour Data	Pole Vectors
Maximum Density	14.27%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Planar Sliding
Slope Dip	29
Slope Dip Direction	23
Friction Angle	38°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Planar Sliding (All)	0	81	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	81 (69 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

FALLA PLANAR



Color	Density Concentrations
0.00 - 1.50	
1.50 - 3.00	
3.00 - 4.50	
4.50 - 6.00	
6.00 - 7.50	
7.50 - 9.00	
9.00 - 10.50	
10.50 - 12.00	
12.00 - 13.50	
13.50 - 15.00	

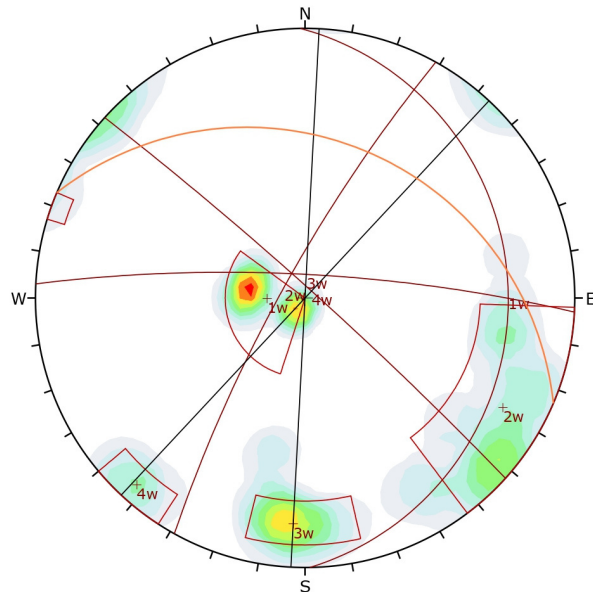
Contour Data	Pole Vectors
Maximum Density	14.27%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Wedge Sliding
Slope Dip	29
Slope Dip Direction	23
Friction Angle	38°

Weighted Results	Critical	Total	%
Wedge Sliding	0	3268	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	81 (69 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	3268
Hemisphere	Lower
Projection	Equal Angle

FALLA POR CUÑA



Color	Density Concentrations
0.00 - 1.50	
1.50 - 3.00	
3.00 - 4.50	
4.50 - 6.00	
6.00 - 7.50	
7.50 - 9.00	
9.00 - 10.50	
10.50 - 12.00	
12.00 - 13.50	
13.50 - 15.00	

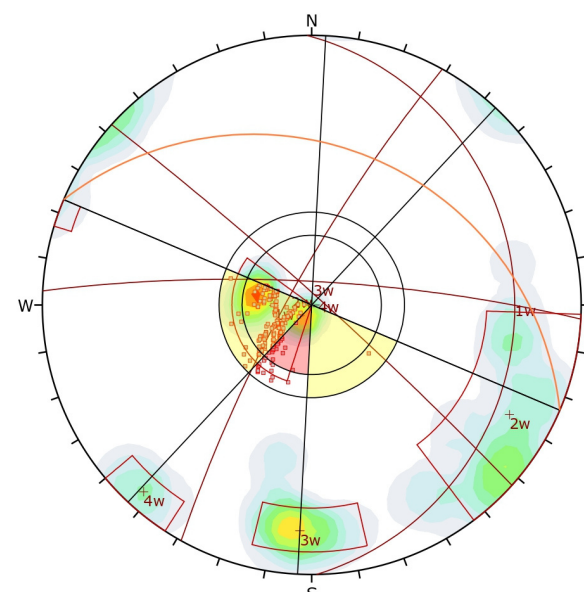
Contour Data	Pole Vectors
Maximum Density	14.27%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Flexural Toppling
Slope Dip	29
Slope Dip Direction	23
Friction Angle	38°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Flexural Toppling (All)	0	81	0.00%

Plot Mode	Pole Vectors
Vector Count (Weighted)	81 (69 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Hemisphere	Lower
Projection	Equal Angle

FALLA POR VUELCO FLEXURAL



Color	Density Concentrations
0.00 - 1.50	
1.50 - 3.00	
3.00 - 4.50	
4.50 - 6.00	
6.00 - 7.50	
7.50 - 9.00	
9.00 - 10.50	
10.50 - 12.00	
12.00 - 13.50	
13.50 - 15.00	

Contour Data	Pole Vectors
Maximum Density	14.27%
Contour Distribution	Fisher
Counting Circle Size	1.0%

Kinematic Analysis	Direct Toppling
Slope Dip	29
Slope Dip Direction	23
Friction Angle	38°
Lateral Limits	20°

Weighted Results	Critical	Total	%
Direct Toppling (Intersection)	26	3268	0.81%
Oblique Toppling (Intersection)	222	3268	6.80%
Base Plane (All)	26	81	31.50%
Base Plane (Set 1)	26	28	91.60%

Plot Mode	Pole Vectors
Vector Count (Weighted)	81 (69 Entries)
Terzaghi Weighting	Minimum Bias Angle 15°
Intersection Mode	Grid Data Planes
Intersections Count (Weighted)	3268
Hemisphere	Lower
Projection	Equal Angle

FALLA POR VUELCO DIRECTO



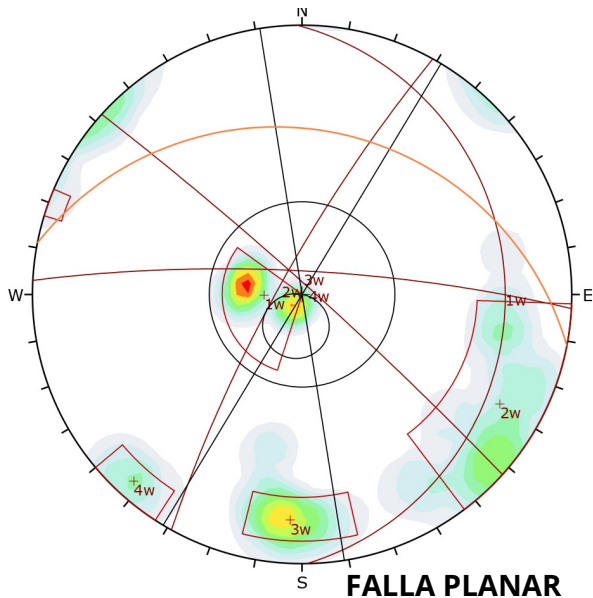
ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-09

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023



Color		Density Concentrations	
		0.00	- 1.50
		1.50	- 3.00
		3.00	- 4.50
		4.50	- 6.00
		6.00	- 7.50
		7.50	- 9.00
		9.00	- 10.50
		10.50	- 12.00
		12.00	- 13.50
		13.50	- 15.00

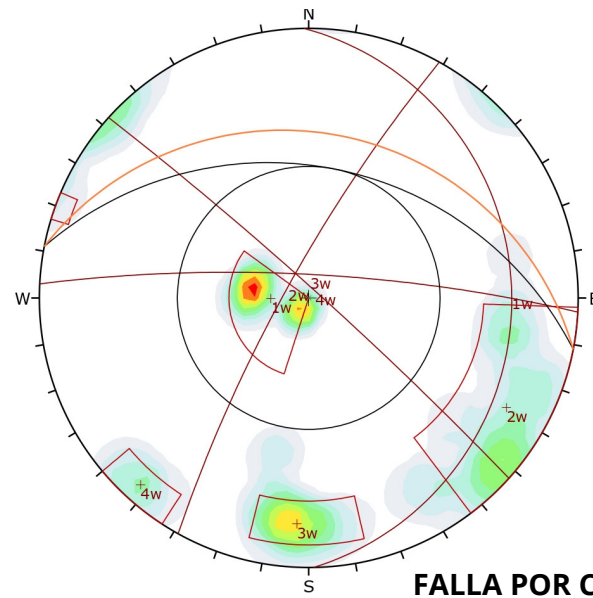
Contour Data		Pole Vectors	
Maximum Density	14.27%		
Contour Distribution	Fisher		
Counting Circle Size	1.0%		

Kinematic Analysis		Planar Sliding	
Slope Dip	27		
Slope Dip Direction	11		
Friction Angle	38°		
Lateral Limits	20°		

Weighted Results			
	Critical	Total	%
Planar Sliding (All)	0	81	0.00%

Plot Mode		Pole Vectors	
Vector Count (Weighted)	81 (69 Entries)		
Terzaghi Weighting	Minimum Bias Angle 15°		
Hemisphere	Lower		
Projection	Equal Angle		

FALLA PLANAR



Symbol	Feature
■	Critical Intersection

Color		Density Concentrations	
		0.00	- 1.50
		1.50	- 3.00
		3.00	- 4.50
		4.50	- 6.00
		6.00	- 7.50
		7.50	- 9.00
		9.00	- 10.50
		10.50	- 12.00
		12.00	- 13.50
		13.50	- 15.00

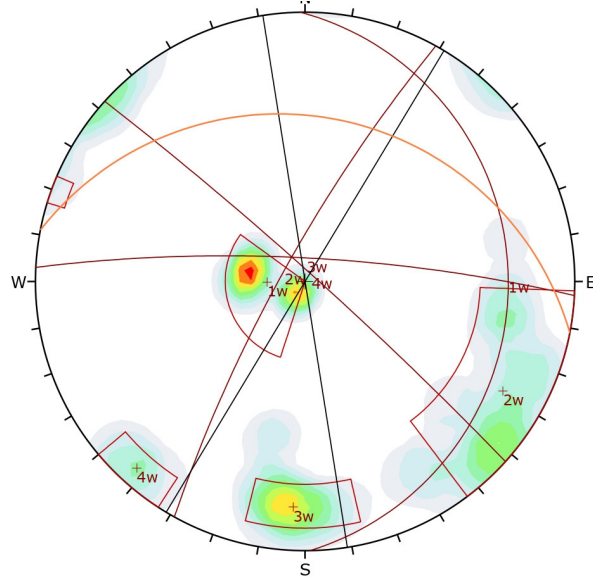
Contour Data		Pole Vectors	
Maximum Density	14.27%		
Contour Distribution	Fisher		
Counting Circle Size	1.0%		

Kinematic Analysis		Wedge Sliding	
Slope Dip	27		
Slope Dip Direction	11		
Friction Angle	38°		

Weighted Results			
	Critical	Total	%
Wedge Sliding	0	3268	0.00%

Plot Mode		Pole Vectors	
Vector Count (Weighted)	81 (69 Entries)		
Terzaghi Weighting	Minimum Bias Angle 15°		
Intersection Mode	Grid Data Planes		
Intersections Count (Weighted)	3268		
Hemisphere	Lower		
Projection	Equal Angle		

FALLA POR CUÑA



Color		Density Concentrations	
		0.00	- 1.50
		1.50	- 3.00
		3.00	- 4.50
		4.50	- 6.00
		6.00	- 7.50
		7.50	- 9.00
		9.00	- 10.50
		10.50	- 12.00
		12.00	- 13.50
		13.50	- 15.00

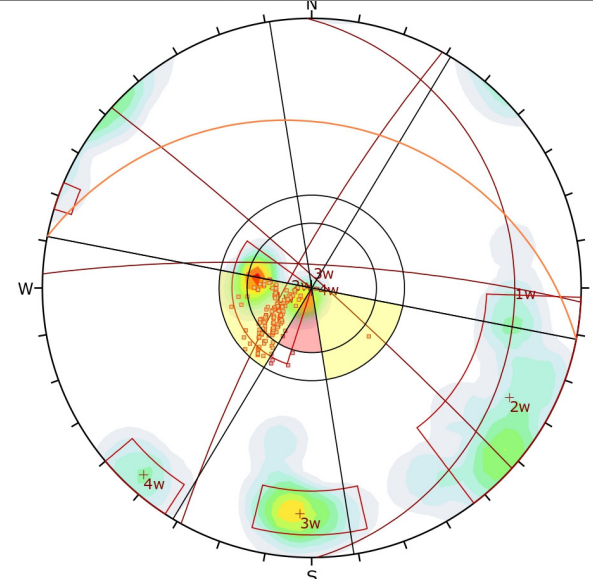
Contour Data		Pole Vectors	
Maximum Density	14.27%		
Contour Distribution	Fisher		
Counting Circle Size	1.0%		

Kinematic Analysis		Flexural Toppling	
Slope Dip	27		
Slope Dip Direction	11		
Friction Angle	38°		
Lateral Limits	20°		

Weighted Results			
	Critical	Total	%
Flexural Toppling (All)	0	81	0.00%

Plot Mode		Pole Vectors	
Vector Count (Weighted)	81 (69 Entries)		
Terzaghi Weighting	Minimum Bias Angle 15°		
Hemisphere	Lower		
Projection	Equal Angle		

FALLA POR VUELCO FLEXURAL



Symbol	Feature
■	Critical Intersection

Color		Density Concentrations	
		0.00	- 1.50
		1.50	- 3.00
		3.00	- 4.50
		4.50	- 6.00
		6.00	- 7.50
		7.50	- 9.00
		9.00	- 10.50
		10.50	- 12.00
		12.00	- 13.50
		13.50	- 15.00

Contour Data		Pole Vectors	
Maximum Density	14.27%		
Contour Distribution	Fisher		
Counting Circle Size	1.0%		

Kinematic Analysis		Direct Toppling	
Slope Dip	27		
Slope Dip Direction	11		
Friction Angle	38°		
Lateral Limits	20°		

Weighted Results			
	Critical	Total	%
Direct Toppling (Intersection)	1	3268	0.03%
Oblique Toppling (Intersection)	198	3268	6.04%
Base Plane (All)	21	81	26.01%
Base Plane (Set 1)	21	28	75.62%

Plot Mode		Pole Vectors	
Vector Count (Weighted)	81 (69 Entries)		
Terzaghi Weighting	Minimum Bias Angle 15°		
Intersection Mode	Grid Data Planes		
Intersections Count (Weighted)	3268		
Hemisphere	Lower		
Projection	Equal Angle		

FALLA POR VUELCO DIRECTO



ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

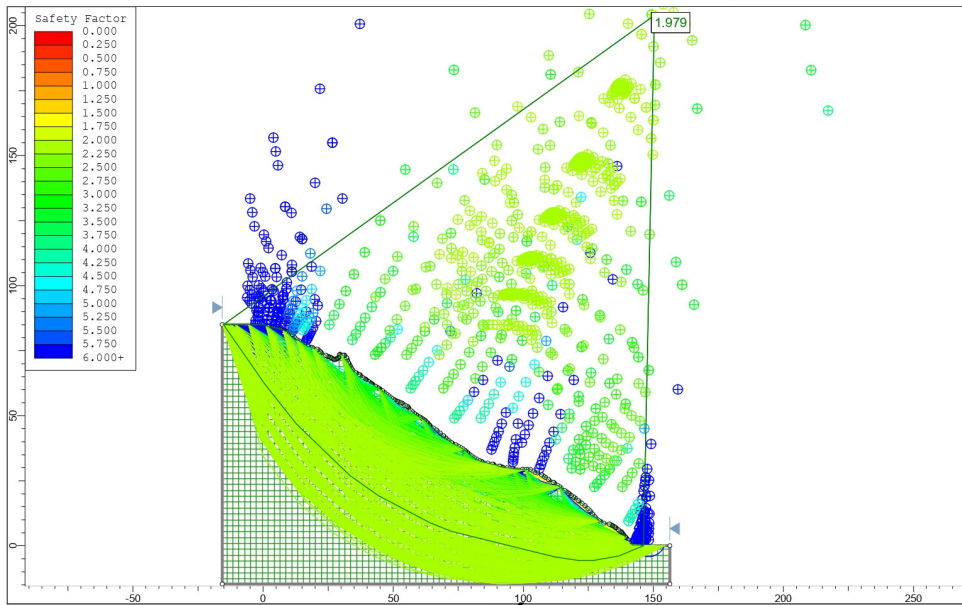
ANALISIS DE ESTABILIDAD CINEMATICO

TALUD: S-10

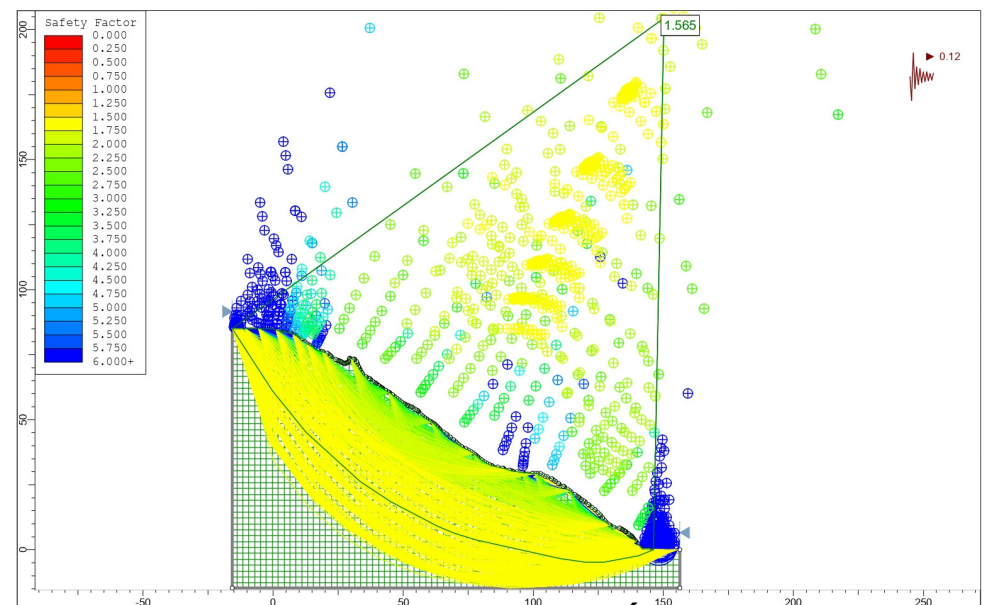
BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023

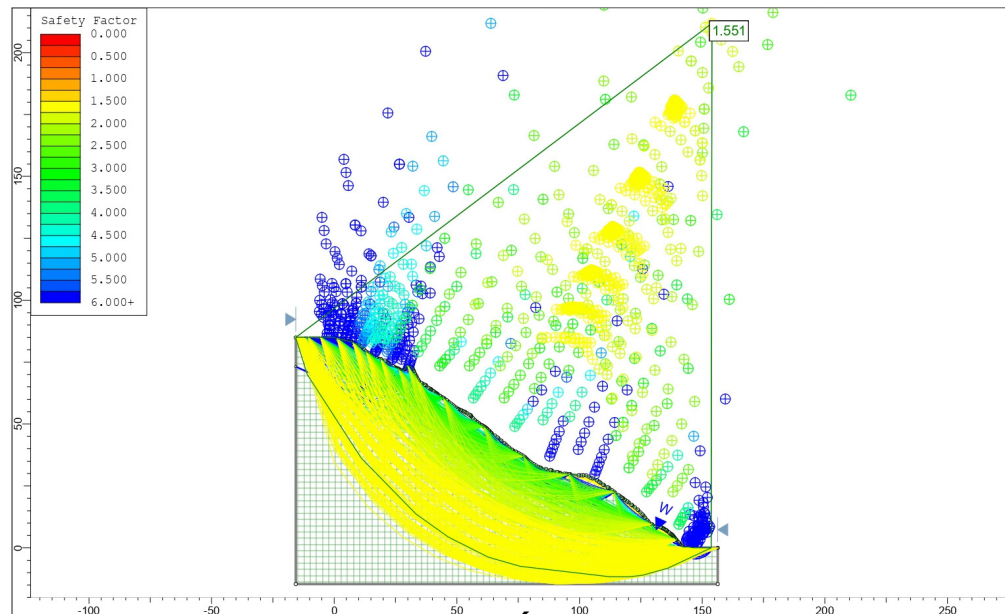
**ANEXO F: MODELO DE ESTABILIDAD POR MÉTODO
DE EQUILIBRIO LÍMITE**



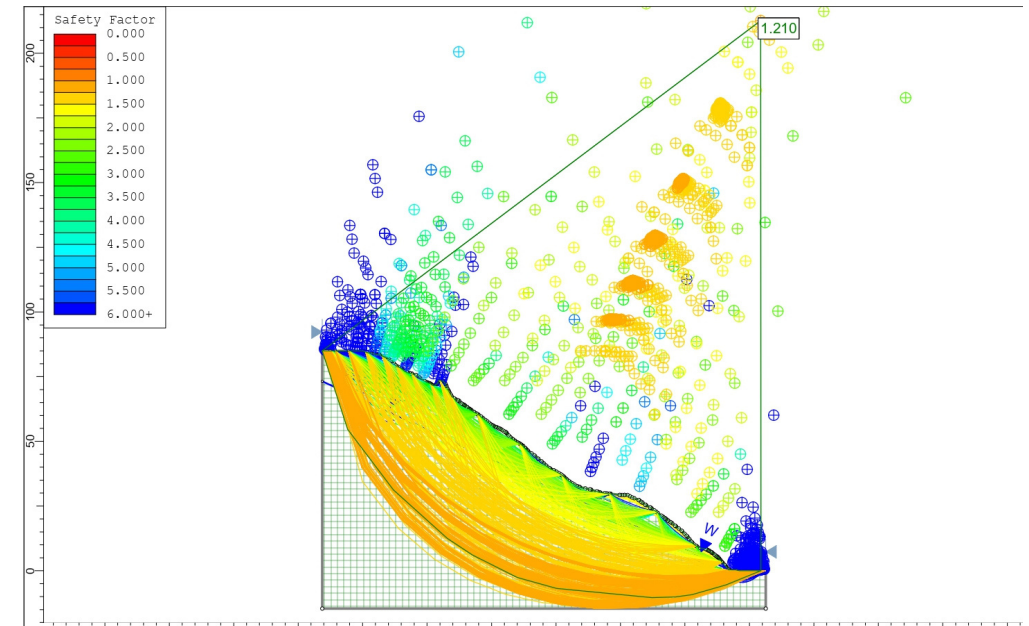
SECO - ESTÁTICO



SECO- PSEUDOESTÁTICO



SATURADO - ESTÁTICO



SATURADO - PSEUDO ESTÁTICO



ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023

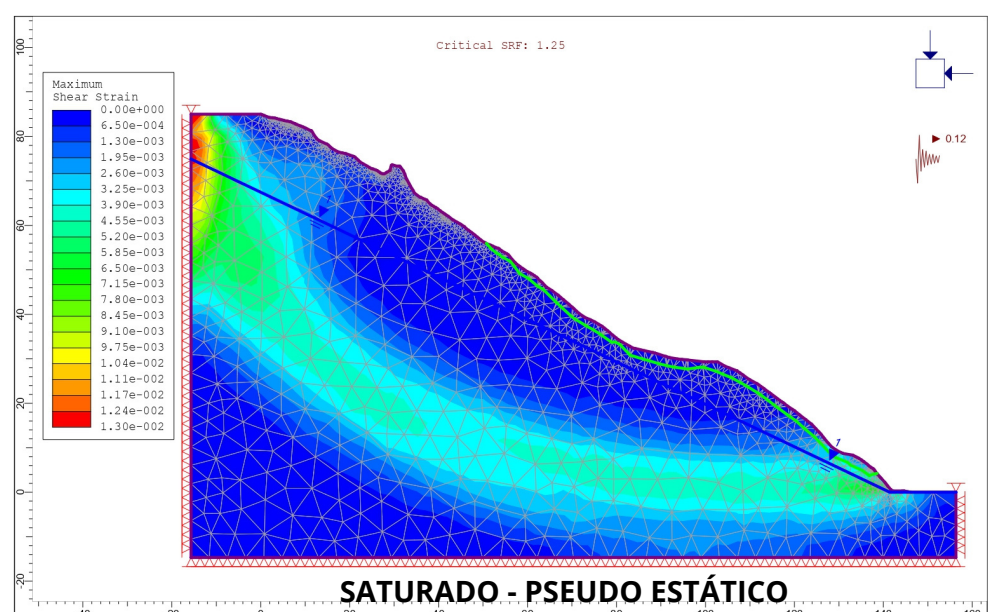
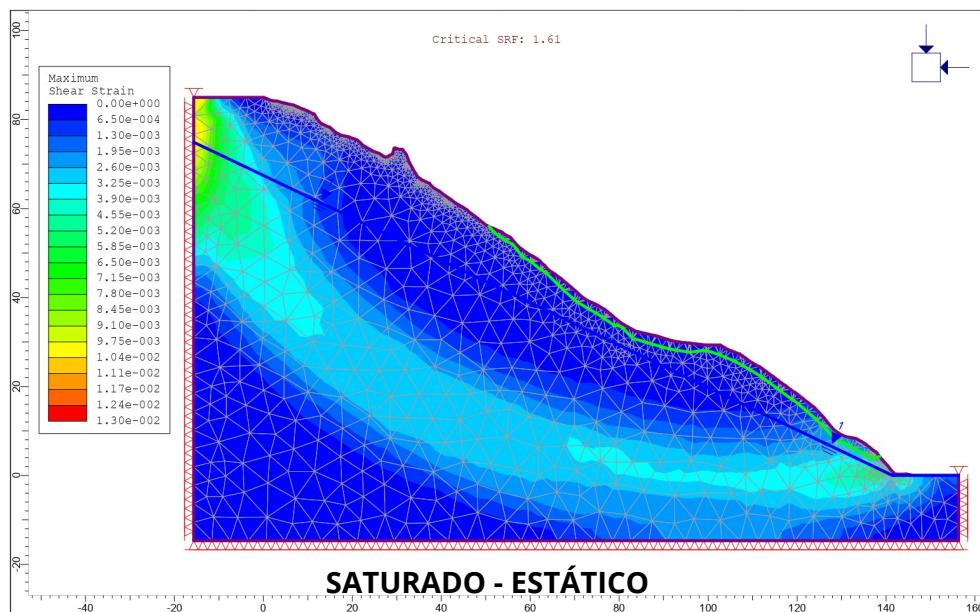
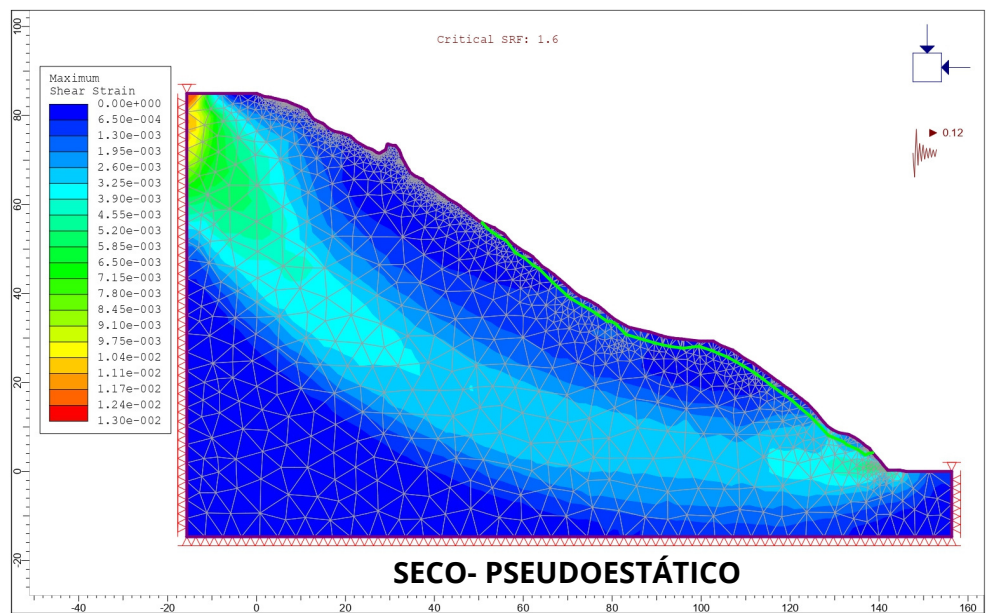
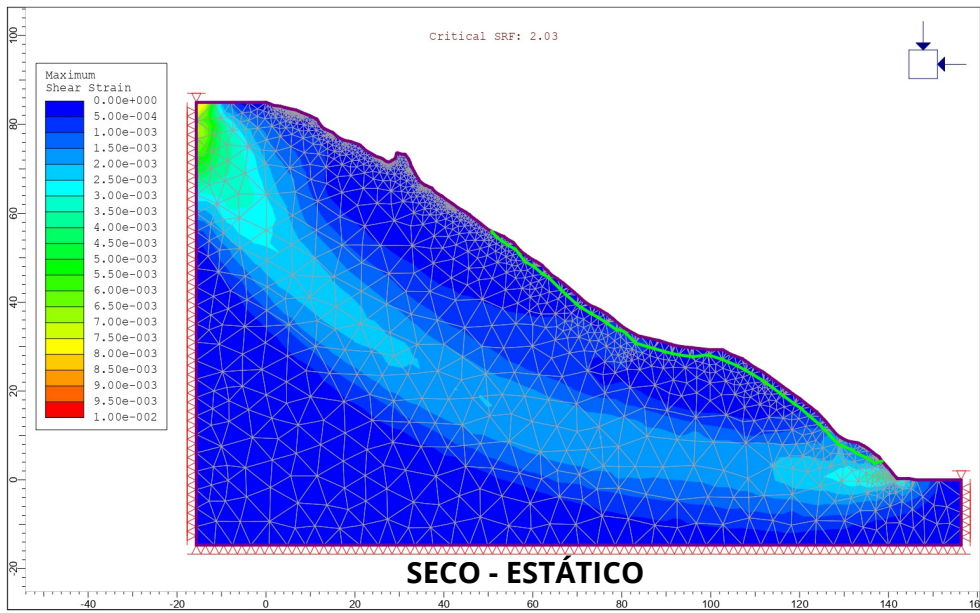
ANÁLISIS DE ESTABILIDAD POR EQUILIBRIO LIMITE

TALUD: S-07

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023

**ANEXO G: MODELO DE ESTABILIDAD POR MÉTODO
DE ELEMENTOS FINITOS**



ANALISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILISTICO Y PROPUESTA DE ESTABILIZACION - PUNO, 2023

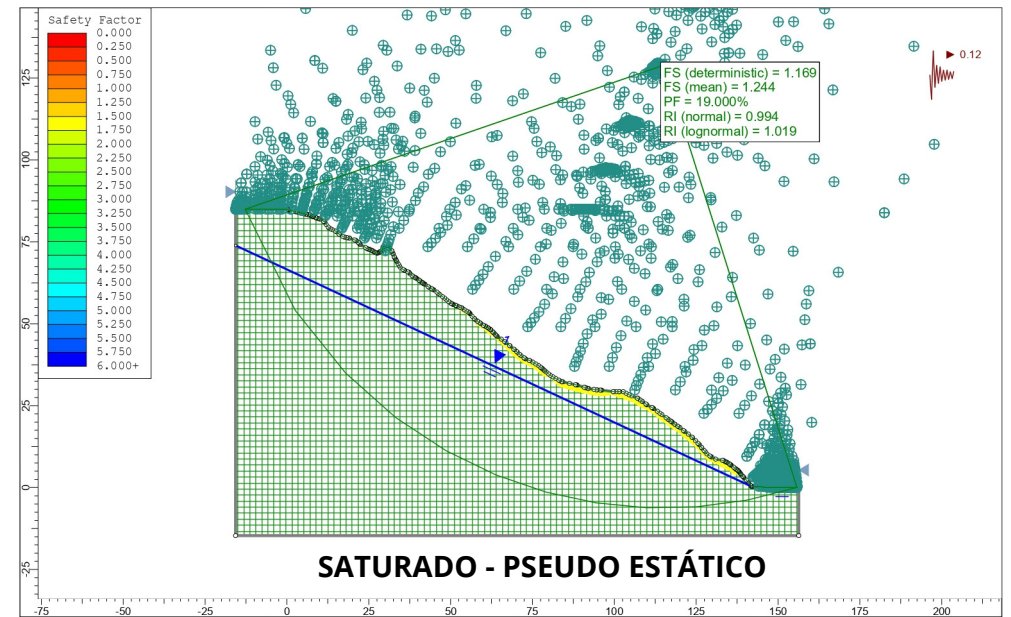
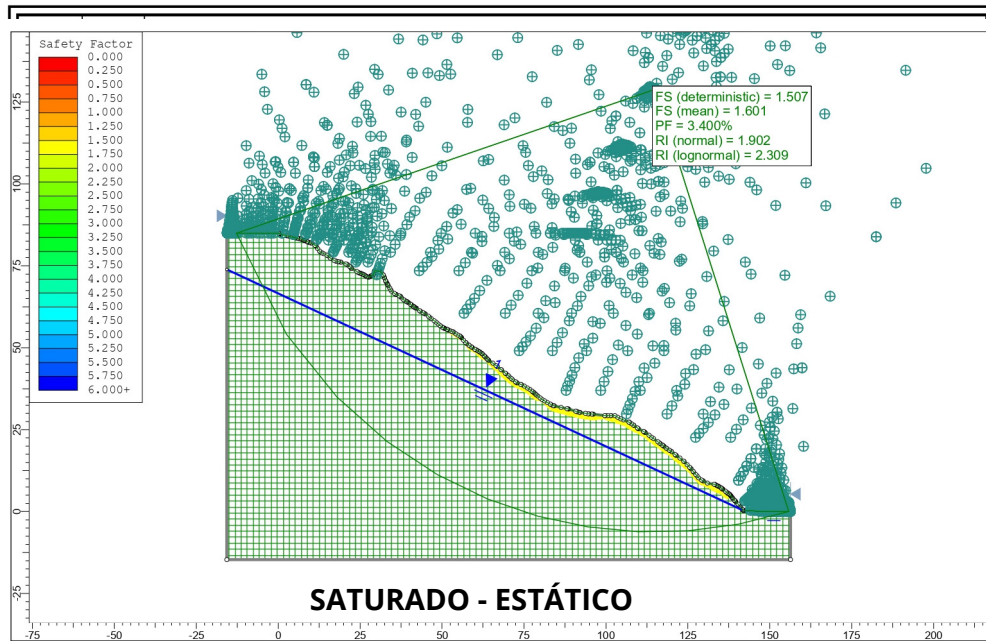
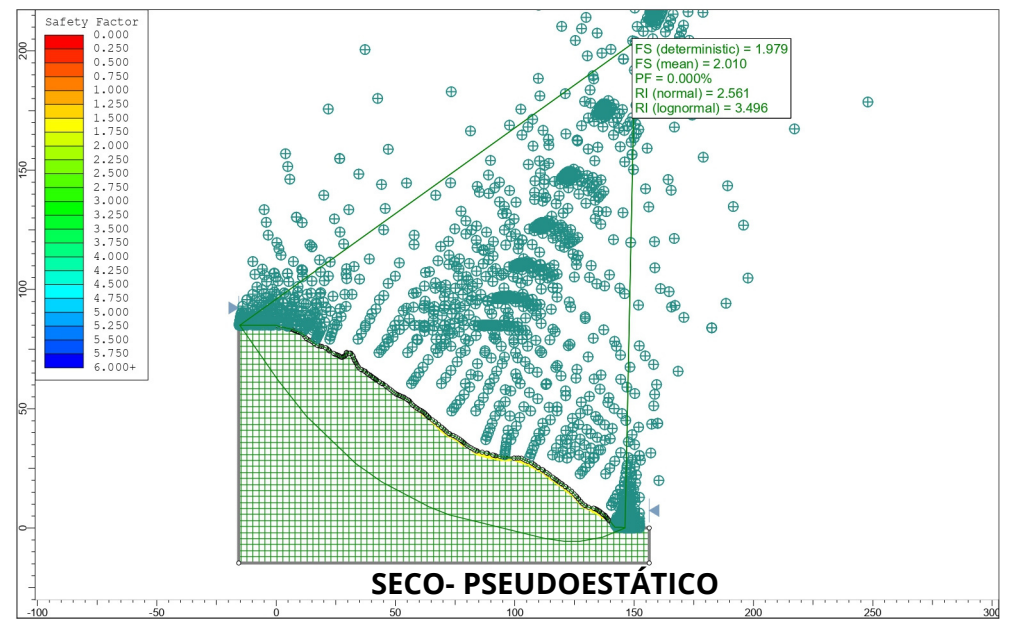
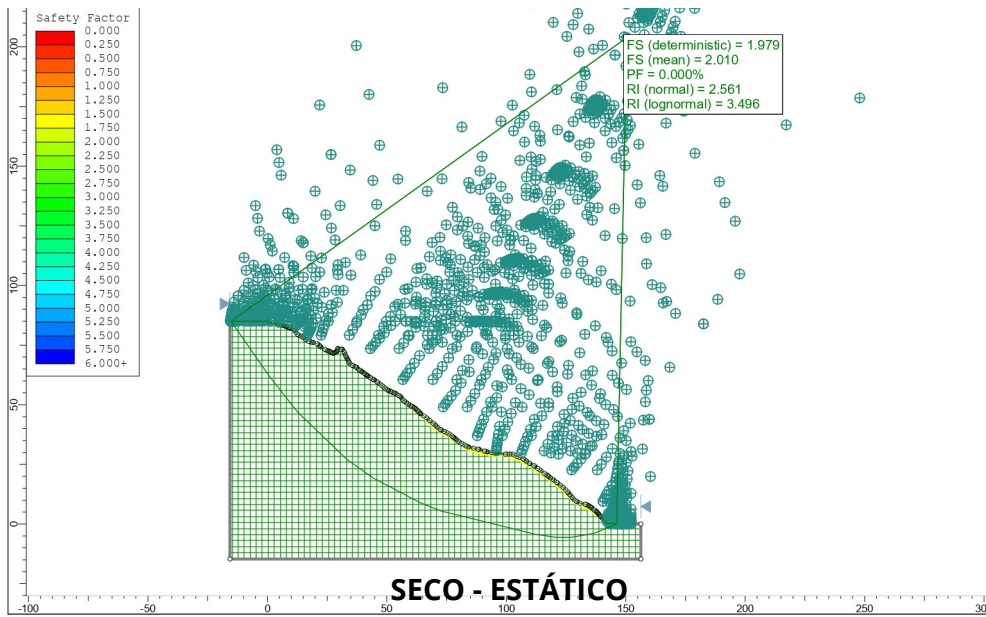
ANALISIS DE ESTABILIDAD POR ELEMENTOS FINITOS

TALUD: S-07

BACHILLER: MARCELO JOSE CUENTAS MERCADO

FECHA: DICIEMBRE 2023

**ANEXO H: MODELO DE ESTABILIDAD POR MÉTODO
PROBABILISTICO**



ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023

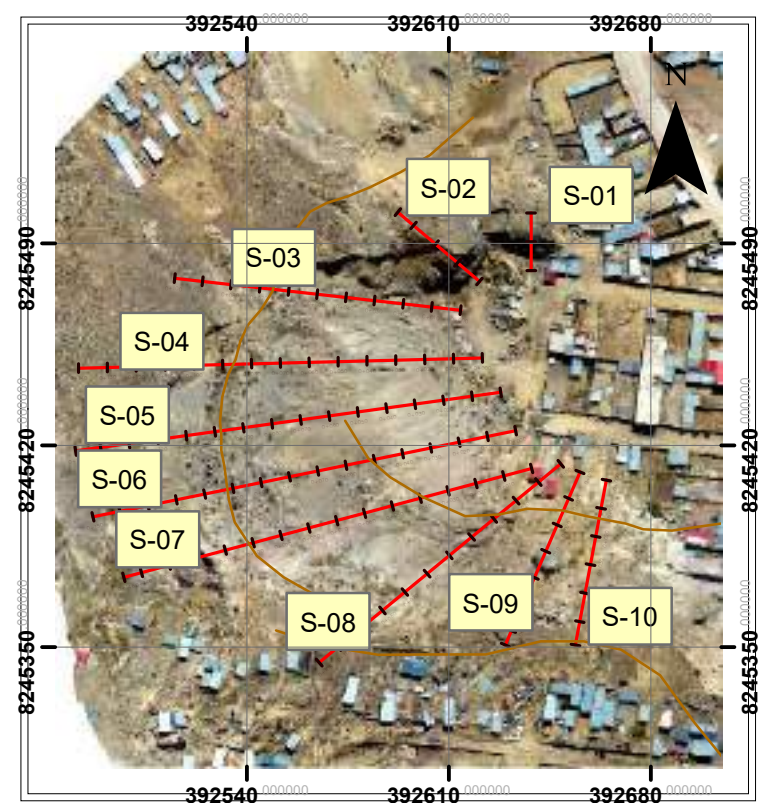
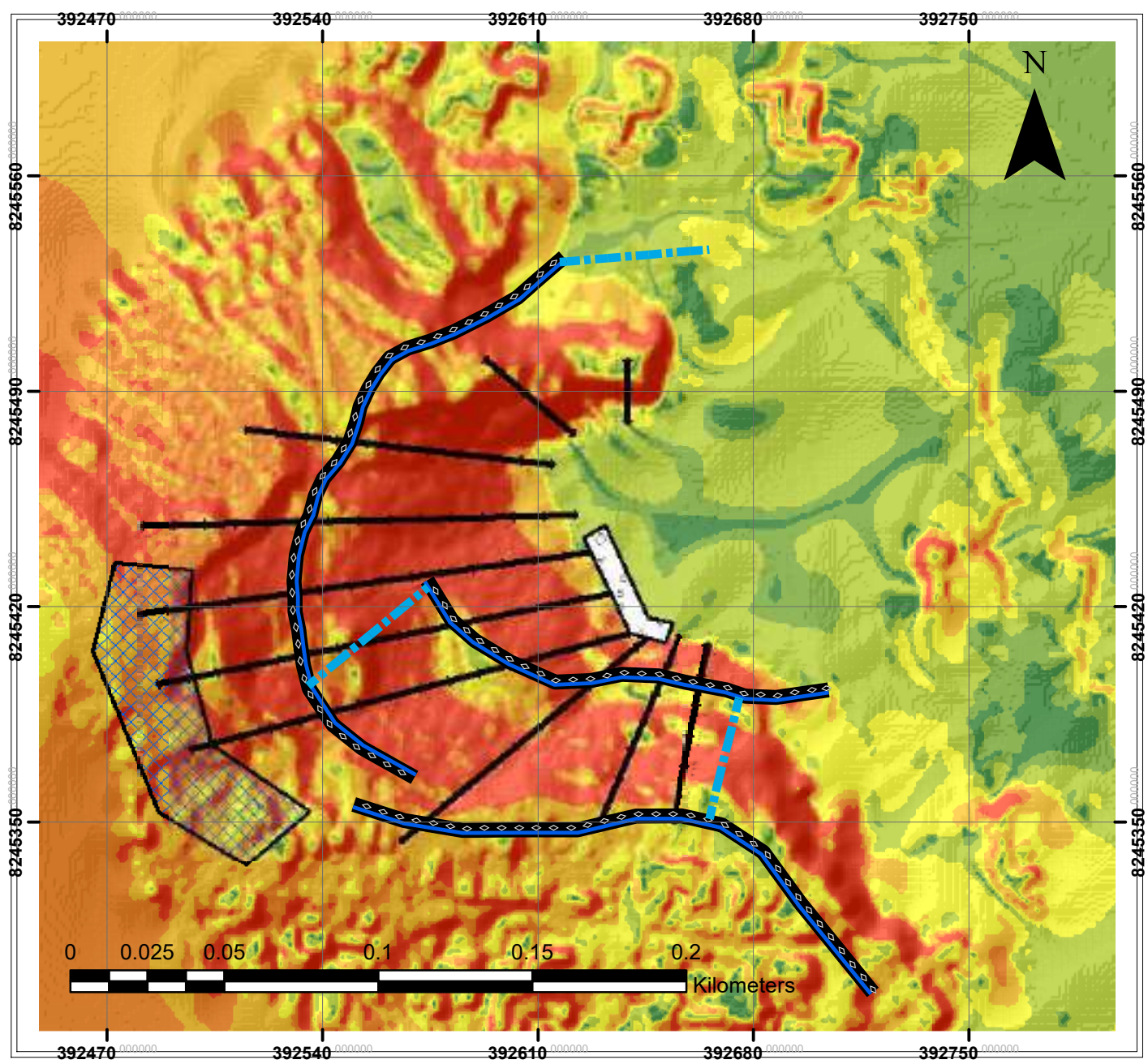
ANÁLISIS DE ESTABILIDAD PROBABILÍSTICO

TALUD: S-07

BACHILLER: MARCELO JOSE CUENTAS MERCADO

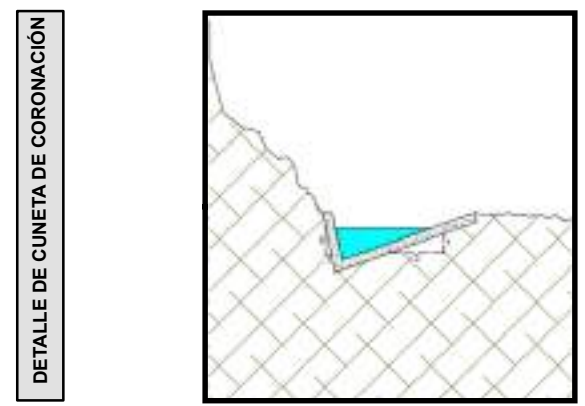
FECHA: DICIEMBRE 2023

ANEXO I: PLANO DE PENDIENTES Y PROPUESTA DE ESTABILIZACIÓN



LEYENDA

- SISTEMA DE DRENAJE SUPERFICIAL
- GAVIONES
- ZONA DE CORTE (CABEZA DEL TALUD)



CLASIFICACIÓN DE PENDIENTES			
COLOR	PENDIENTE (%)	DESCRIPCIÓN	Media
	0 - <3	Casi a nivel	35.59%
	3 - <5	Ligeramente ondulado	
	5 - <12	Moderadamente ondulado	
	12 - <25	Fuertemente ondulado	
	25 - <45	Lomajes	
	45 - <60	De cerros	
	>60	De montañas	

ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023

ELABORADO POR: MARCELO CUENTAS MERCADO

ESCALA: INDICADA

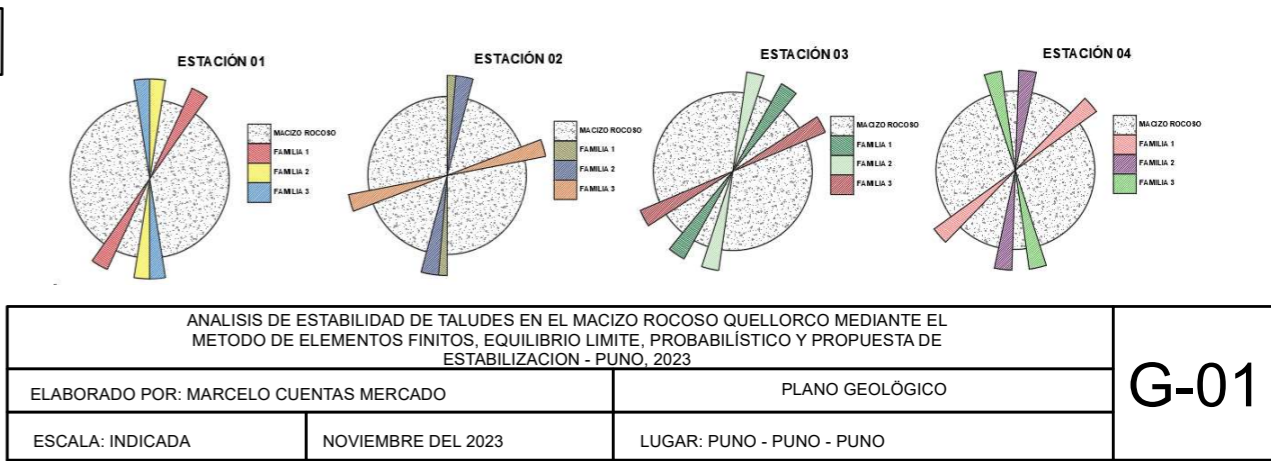
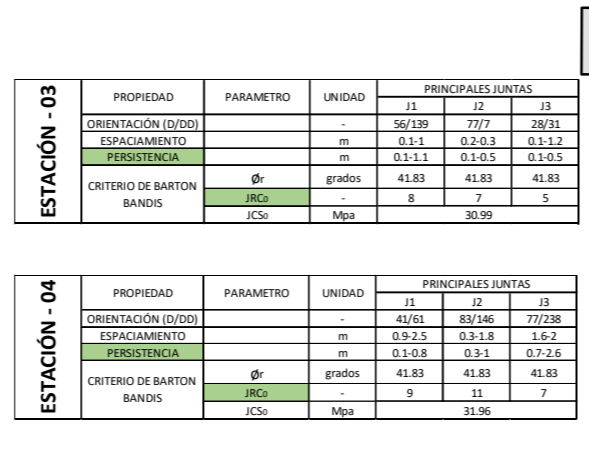
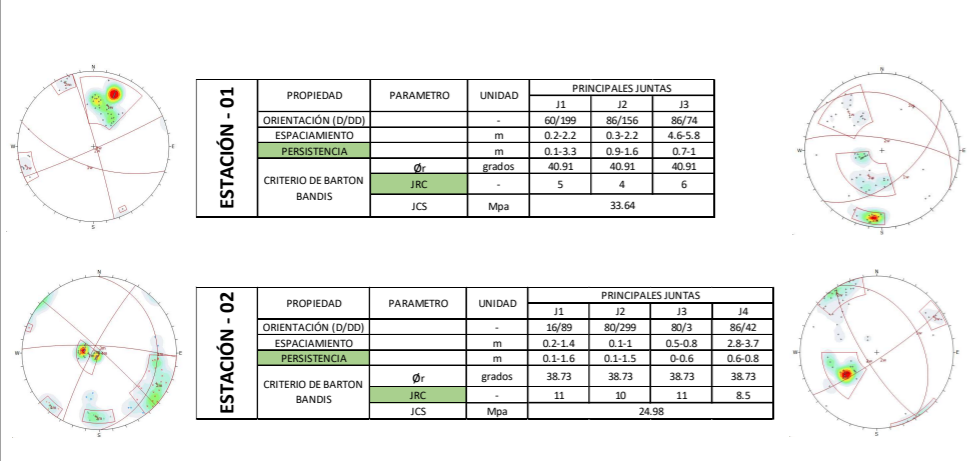
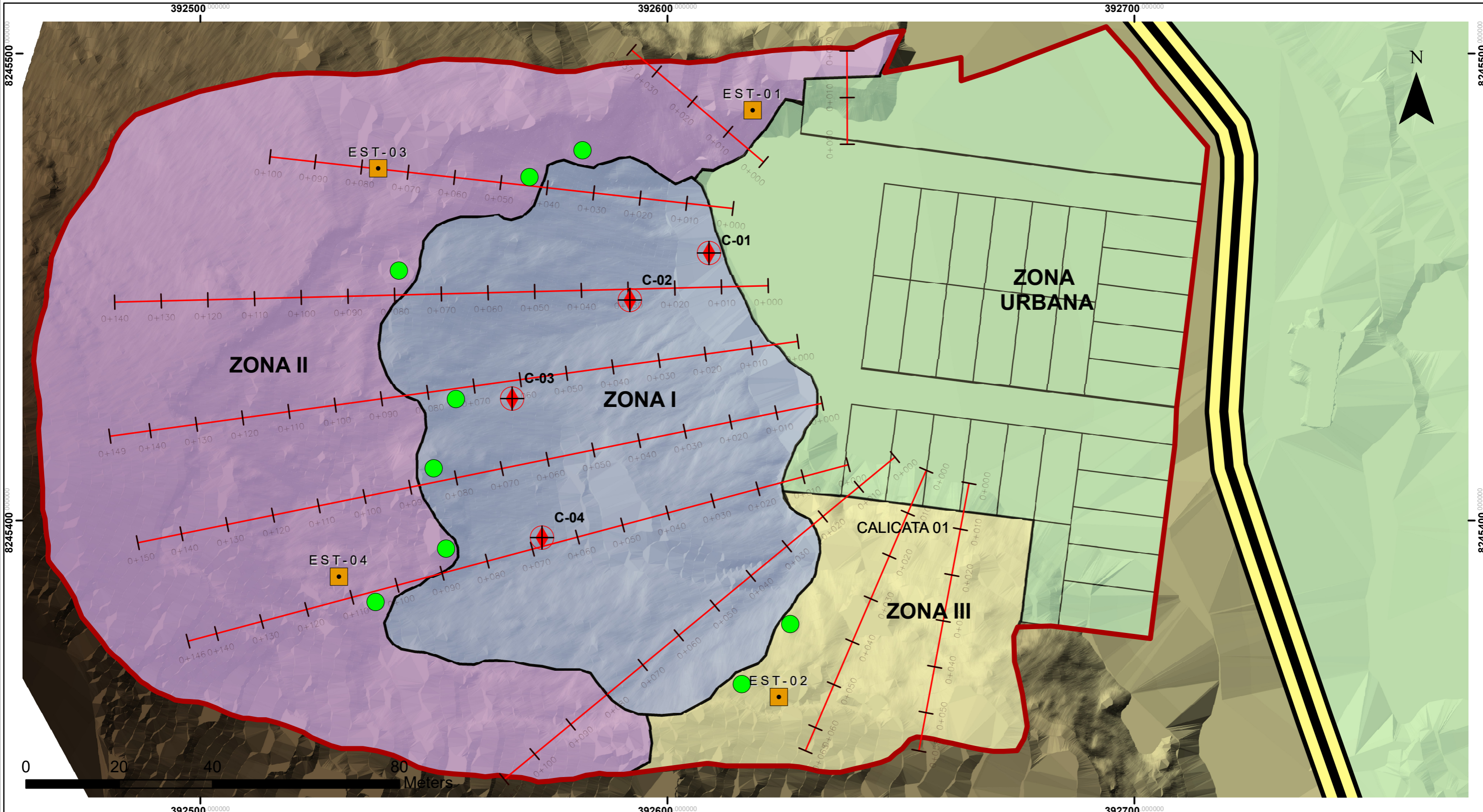
DICIEMBRE DEL 2023

PLANO DE PENDIENTES - CON PROPUESTA DE ESTABILIDAD

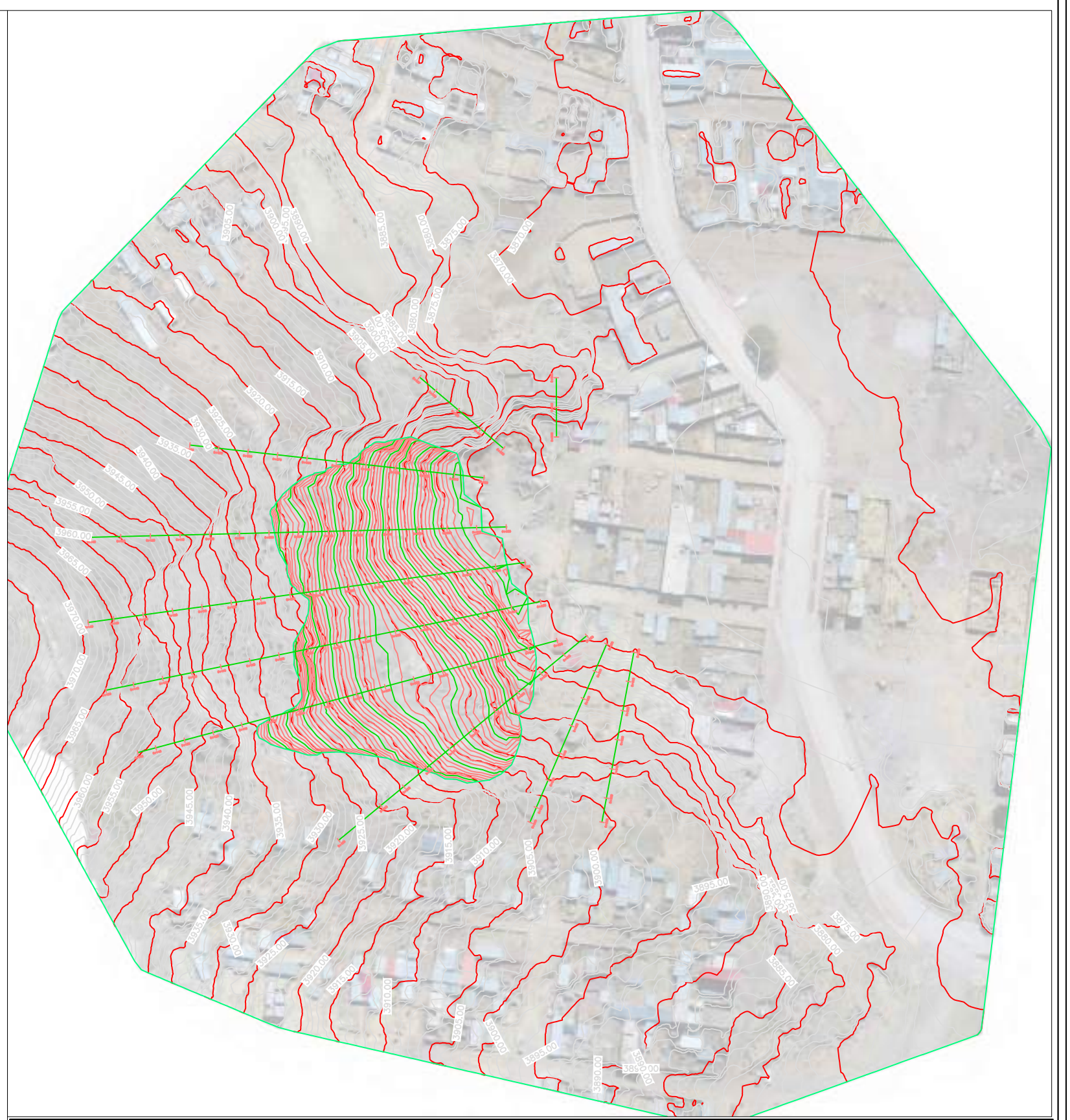
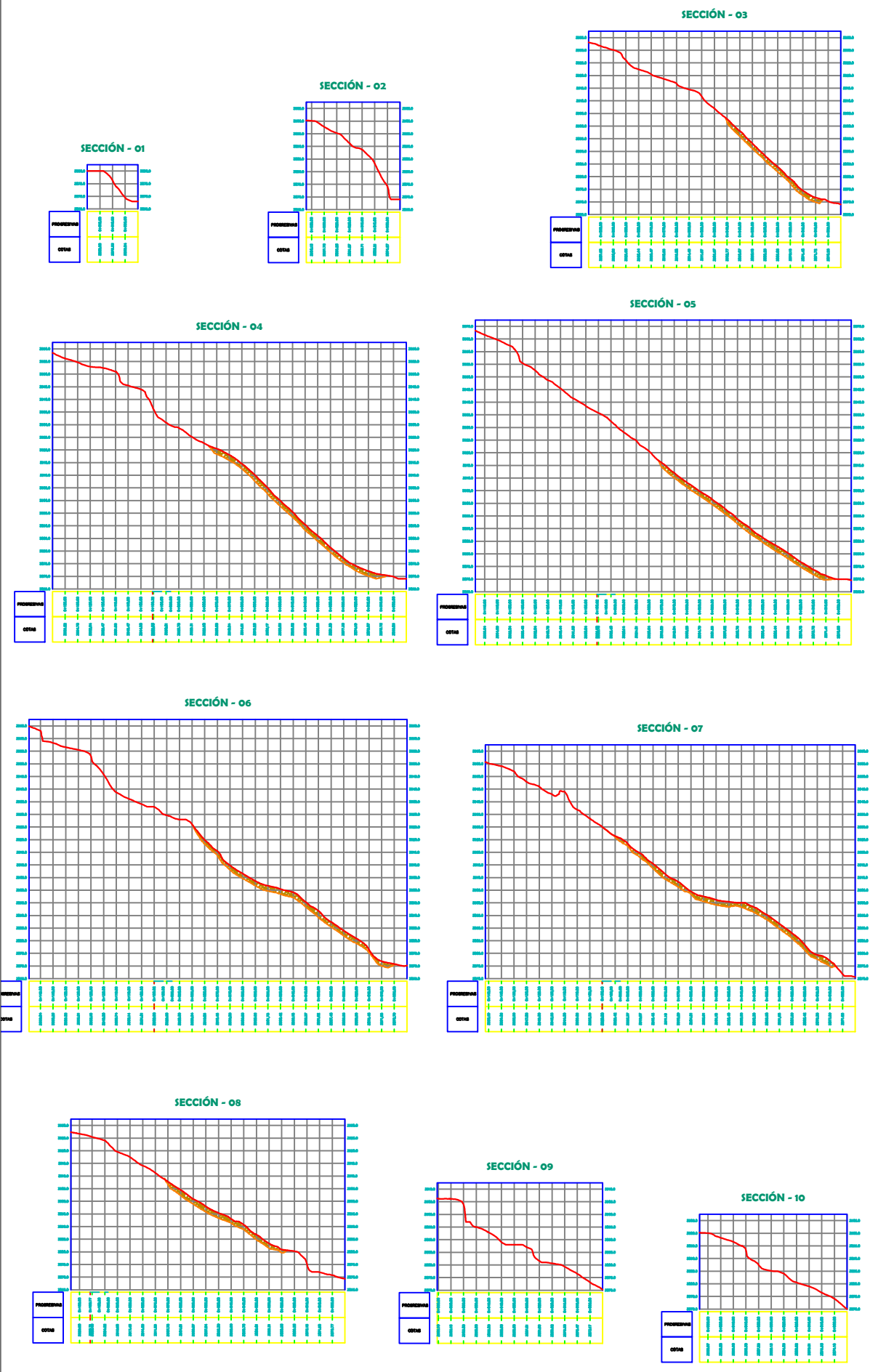
LUGAR: PUNO - PUNO - PUNO

H-01

ANEXO J: PLANO GEOMECÁNICO

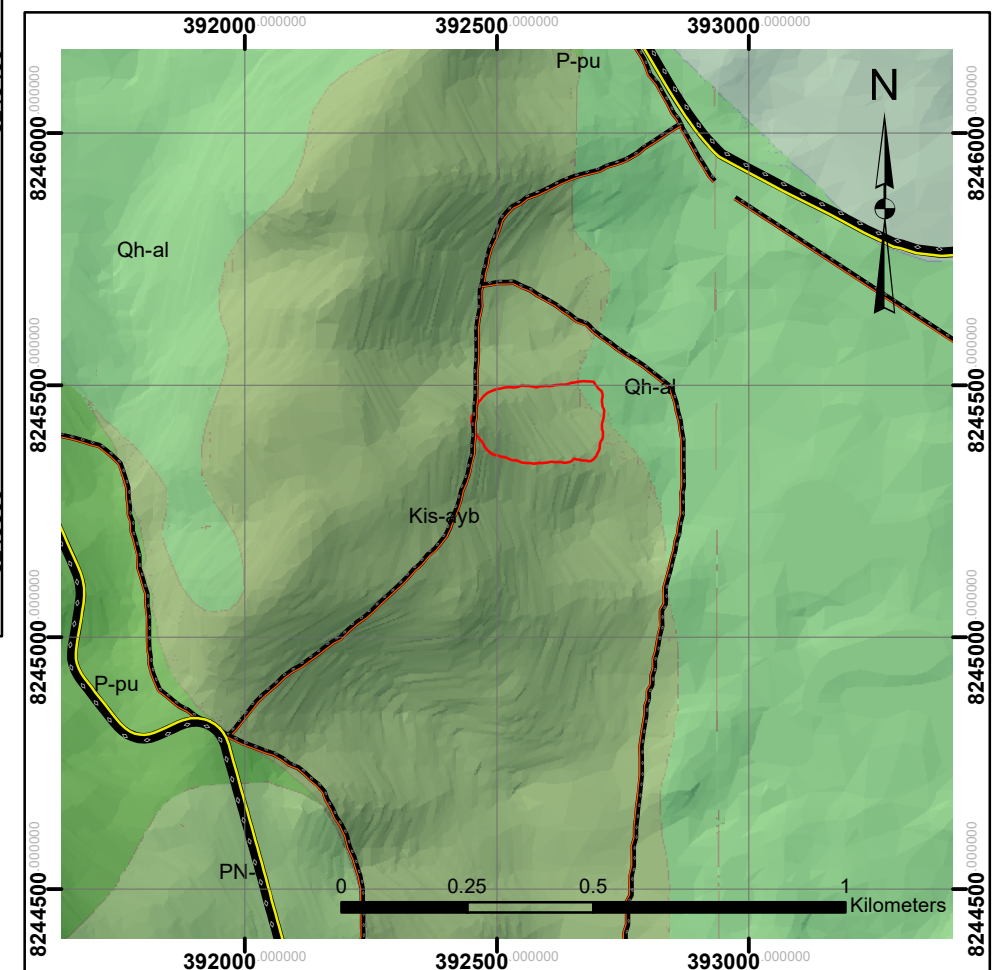
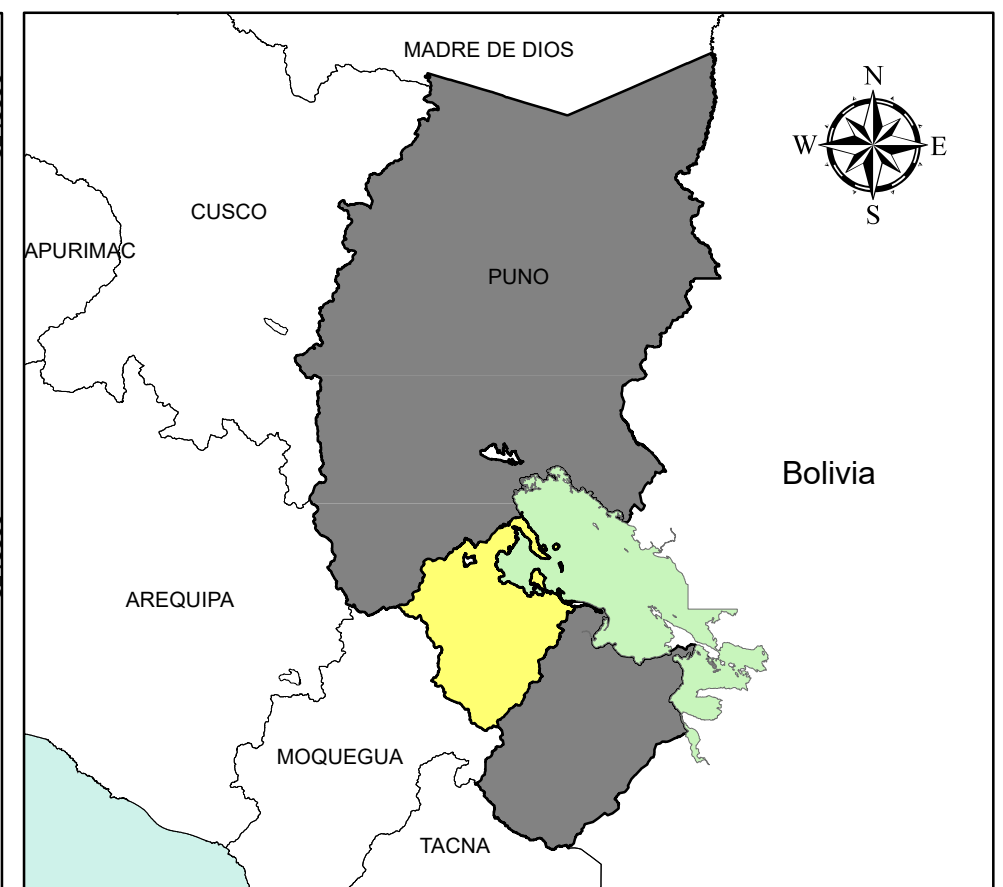
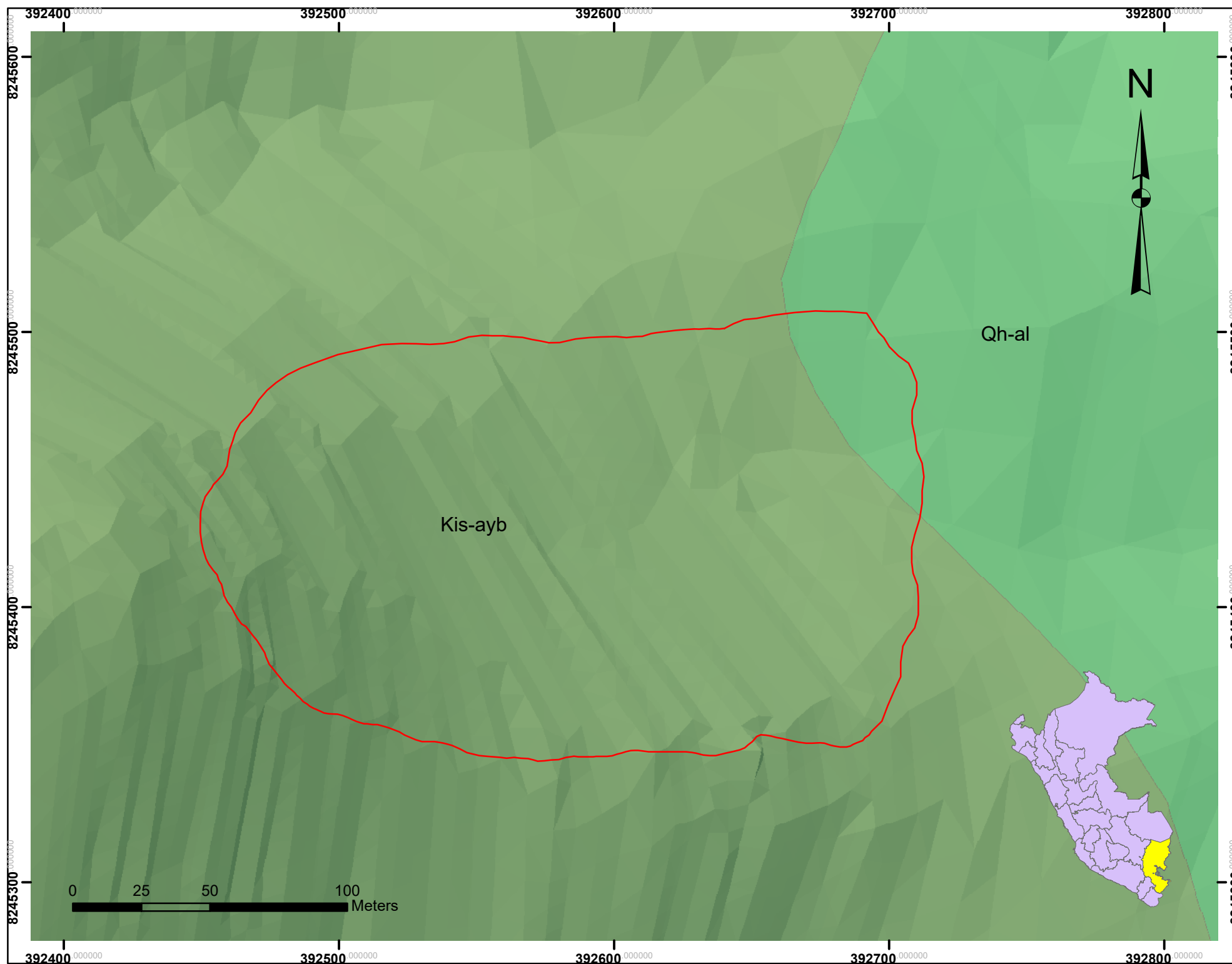


ANEXO K: PLANO TOPOGRÁFICO



ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN – PUNO, 2023			T-01
ELABORADO POR: BACH. MARCELO JOSE CUENTAS MERCADO		PLANO TOPOGRAFICO	
ESCALA: INDICADA	NOVIEMBRE DEL 2023	LUGAR: PUNO – PUNO – PUNO	

ANEXO L: PLANO GEOTÉCNICO



LEYENDA GEOLÓGICA		Acumulación de grava, arena, limo y arcilla con clastos subangulosos a angulosos de diferente composición. (Qh-al)
		Calizas masivas grises y marrones, limoarcillitas rojas. (Kis-ayb)
		Conglomerados polimícticos, areniscas blancas y rojizas. (P-pu)
		Flujos andesíticos, areniscas y limolitas gris violáceas, con conglomerados. (PN-t)

LEYENDA		Lago Tititaca
		Vías nacionales
		Vías secundarias
		Zona del Proyecto

ANÁLISIS DE ESTABILIDAD DE TALUDES EN EL MACIZO ROCOSO QUELLORCO MEDIANTE EL METODO DE ELEMENTOS FINITOS, EQUILIBRIO LIMITE, PROBABILÍSTICO Y PROPUESTA DE ESTABILIZACIÓN - PUNO, 2023		G-01	
ELABORADO POR: MARCELO CUENTAS MERCADO			PLANO GEOLÓGICO
ESCALA: INDICADA	OCTUBRE DEL 2023		LUGAR: PUNO - PUNO - PUNO

ANEXO M: PANEL FOTOGRÁFICO



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	10/08/2023	001

DESCRIPCION: Toma panorámica del macizo rocoso Quellorco con la zona de estudio sombreada.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	20/08/2023	002

DESCRIPCION: Mapeo geomecánico en la estación 4 , 3, 2 y 1 del afloramiento del macizo rocoso del cerro Quellorco.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	20/08/2023	003
DESCRIPCION: Determinación de buzamiento y dirección de buzamiento en la estación geomecánica 4.		



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	20/08/2023	004

DESCRIPCION: Determinación RQD horizontal en la estación geomecánica 3.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	20/08/2023	005

DESCRIPCION: Realización de calicatas y medición de profundidad.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	27/10/2023	006

DESCRIPCION: Ensayo de compresión uniaxial muestra I2-M1



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	27/10/2023	007

DESCRIPCION: Ensayo de compresión uniaxial.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	27/10/2023	008
DESCRIPCION: Ensayo de compresión uniaxial muestra I1-M3.		



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	25/10/2023	009
DESCRIPCION: Pesado de nucleos para ensayo de compresión uniaxial.		



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	25/10/2023	010

DESCRIPCION: Toma de medidas del núcleo I2-M3.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	13/11/2023	011

DESCRIPCION: Ensayo de Tilt Test.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	13/11/2023	012
DESCRIPCION: Medición del Angulo de fricción básico.		



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	08/11/2023	013
DESCRIPCION: Ensayo de peso específico en campo.		



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	08/11/2023	014

DESCRIPCION: Ensayo de peso específico en campo.



	FECHA	Nro. DE FOTOGRAFIA
PANEL FOTOGRAFICO	08/11/2023	015

DESCRIPCION: Medición de diferencia del nivel del espejo de agua en el ensayo de peso específico en campo.