autostrade per l'italia

AUTOSTRADA (A1): MILANO-NAPOLI

AMPLIAMENTO ALLA TERZA CORSIA
NEL TRATTO INCISA - VALDARNO
LOTTO1

PROGETTO ESECUTIVO

DOCUMENTAZIONE GENERALE

GEOLOGIA
INDAGINI GEOGNOSTICHE IN SITO

INDAGINI GEOGNOSTICHE IN SITO - PROGETTO ESECUTIVO (RILIEVI GEOMECCANICI)

IL GEOLOGO	IL RESPONSABILE INTEGRAZIONE PRESTAZIONI SPECIALISTICHE	IL DIRETTORE TECNICO
Dott. Vittorio Boerio Ord. Geol. Lombardia N. 794 **Responsabile Geologia**	Ing. Paola Castiglioni Ord. Ingg. Varese N. 2725	Ing. Orlando Mazza Ord. Ingg. Pavia N. 1496 **Progettazione Nuove Opere Autostradali**

CODICE IDENTIFICATIVO											ORDINATORE
RIFERIMENTO PROGETTO			RIFERIMENTO DIRETTORIO				RIFERIMENTO ELABORATO				
Codice Commessa	Lotto, Sub-Prog, Cod. Appalto	Fase	Capitolo	Paragrafo	W B S	Parte d'opera	Tip.	Disciplina	Progressivo	Rev.	XXX
119941	LL01	PE	DG	GEO	SI000	00000	R	GEO	1024	-0	SCALA -

spea ENGINEERING
gruppo Atlantia

PROJECT MANAGER:	SUPPORTO SPECIALISTICO:	REVISIONE	
Ing. Paola Castiglioni Ord. Ingg. Varese N. 2725	Dott.ssa Maria Bruno Ord. Geol. Lazio N. 668	n.	data
		0	OTTOBRE 2019
REDATTO:	VERIFICATO:		

	VISTO DEL COMMITTENTE	VISTO DEL CONCEDENTE
	autostrade per l'italia IL RESPONSABILE UNICO DEL PROCEDIMENTO Ing. Furio Cruciani	Ministero delle Infrastrutture e dei Trasporti DIPARTIMENTO PER LE INFRASTRUTTURE, GLI AFFARI GENERALI ED IL PERSONALE STRUTTURA DI VIGILANZA SULLE CONCESSIONARIE AUTOSTRADALI

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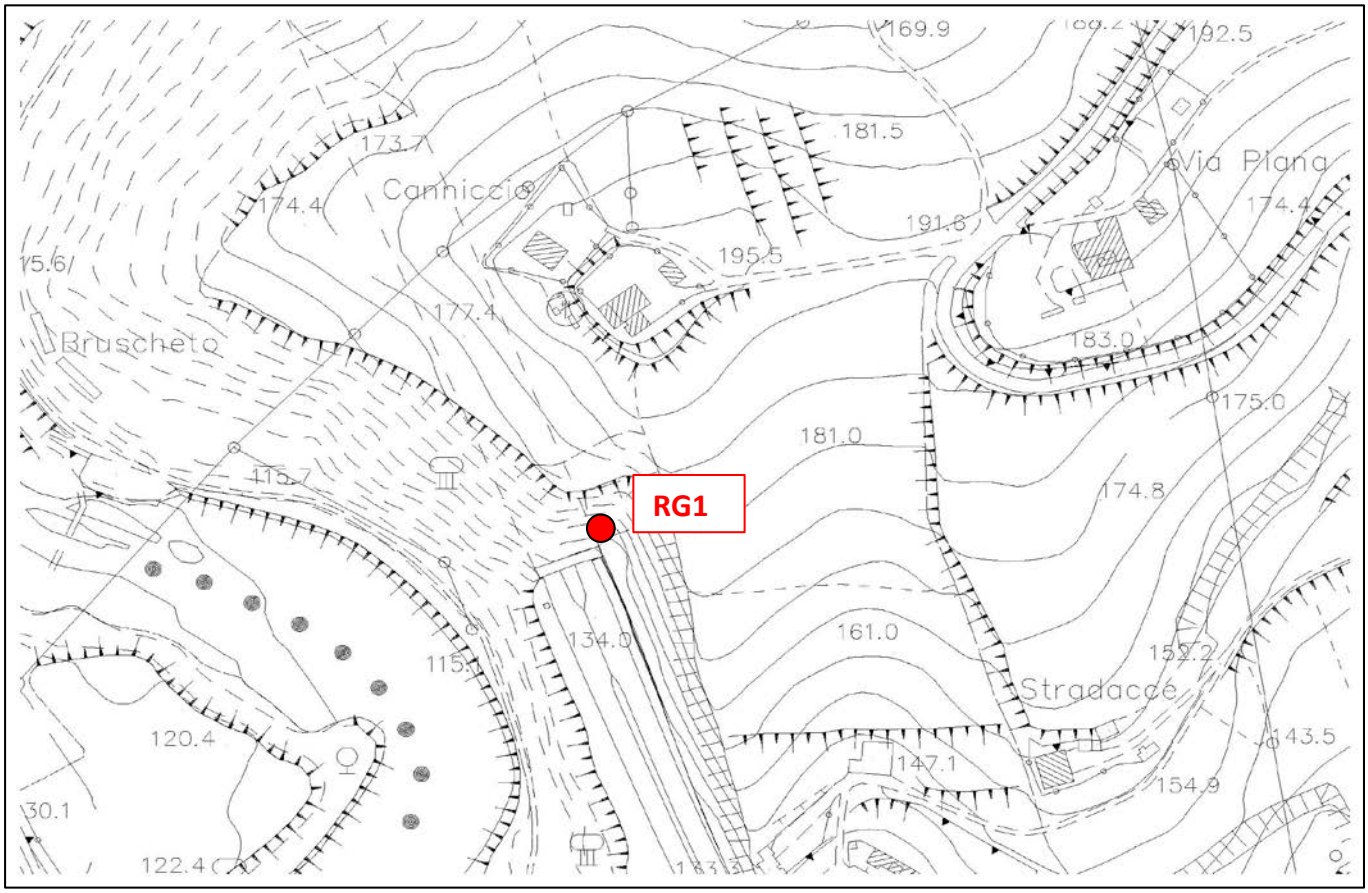
RILIEVO GEOMECCANICO N°1
Ubicazione area di rilievo

Committente	*SPEA ENGINEERING SPA*
Commessa	*A1 Incisa Valdarno (Progetto esecutivo terza corsia)*
Località	*Reggello (FI)*
Coordinate	*Gauss Boaga X: 1697998 Y: 4838399 Quota: 155 m*
Data	*16/05/2018*
Area di rilievo geomeccanico	*Versante imbocco Sud galleria Bruscheto (a ridosso della rete di consolidamento)*

Stralcio planimetrico



RILIEVO GEOMECCANICO N°1
Scheda di sintesi

Committente	*SPEA ENGINEERING SPA*
Commessa	*A1 Incisa Valdarno (Progetto esecutivo terza corsia)*
Località	*Reggello (FI)*
Coordinate	*Gauss Boaga X: 1698002 Y: 4838408 Quota: 155 m*
Data	*16/05/2018*
Area di rilievo geomeccanico	*Versante imbocco Sud galleria Bruscheto (a ridosso della rete di consolidamento)*

Condizioni generali dell'ammasso roccioso

Giacitura del fronte di misura		*[°/°]*	*180/65°*
Giacitura generale del pendio		*[°/°]*	*184/50°*
Dimensioni dell'area di rilievo geomeccanico		*[m x m]*	*2x3.5*
Volume roccioso unitario medio	*[minimo]*	*[cm x cm x cm]*	*2x1x1*
	[massimo]	*[cm x cm x cm]*	*40x10x5*
	[forma]	*[-]*	*paralllepipedo*
Resistenza a compressione monoassiale del materiale roccia:		*litologia*	*Calcare marnoso*
		moda [MPa]	*46*
		variabilità [MPa]	*14-60*
Intercetta delle discontinuità		*[n°/m]*	*25* (*valori modali*)
Numero di discontinuità per metro cubo d'ammasso - J_v		*[n°/m^3]*	*35* (*valori modali*)

Grado di alterazione dell'ammasso	*non alterato*	*debolm. alterato*	*moder. alterato*	*molto alterato*	*decom-posto*
		X			

Condizioni di umidità dell'ammasso	*asciutto*	*umido*	*bagnato*	*stillicidio*	*flusso*
		X			

Geological Strength Index

Struttura in ammassi omogenei	*I*	*B*	*VB*	*B/D/S*	*D*	*L/S*
					X	

Condizioni delle discontinuità	*VG*	*G*	*F*	*P*	*VP*
			X	x	

GSI **32**

Litologia e descrizione geologica generale

Calcare marnoso a grana fine grigio chiaro, avana se alterato a frattura concoide della formazione di Monte Morello.
L' affioramento si presenta debolmente alterato e fortemente fratturato con uno strato alla base massivo con uno spessore di 50 cm circa.
Si riconosce: la stratificazione S0 suborizzontale, spaziatura media 5 cm, con immersione variabile a pochi metri di distanza, e tre set di fratture più alcune fratture random.

Condizioni generali delle discontinuità

set	*giacitura [°/°]*	*spaziatura [cm]*		*persistenza [m]*		*apertura [mm]*		*ALTERAZIONE*				*RESISTENZA*		*Js [-]*		*RUGOSITA'*					*pellicole*			*riempimento*													
								Ja [-]		*ISRM [W1-W5]*		*JCS [MPa]*				*ISRM [I-IX]*	*JRC [-]*		*Jw [-]*		*materiale prevalente*			*materiale prevalente*							*durezza*		*spessore [mm]*	
		media	*variabilità*	*media*	*variabilità*	*media*	*variabilità*	*media*	*variabilità*	*moda*		*media*	*variabilità*	*media*	*variabilità*	*moda*	*media*	*variabilità*	*media*	*variabilità*	*sabbia*	*limo*	*argilla*	*minerali asbestiformi*	*vene minerali*	*sabbia*	*limo*	*argilla*	*scaglie e arg.*	*mat. rigonf.*	*duro*	*tenero*	*< 5*	*> 5*
S0	*2/9*	*5*	*1-40*	*0,24*	*0,2-1,8*	*1,75*	*1-3*	*1*	*1-1,5*	*w1*	*w1-w2*	*12*	*11-13*	*1.5*	*1-1,5*	*V*	*9*	*6-12*	*1.5*	*1-1,5*	-	-	-	-	-	x	x	-	-	-	x	x	-
K1	*103/47*	*7*	*2-20*	*0,1*	*0,5-1,5*	*2*	*2-2*	*1.5*	*1-2*	*w2*	*w1-w2*	*15*	*13-22*	*1.5*	*1-1,5*	*VII*	*8*	*6-8*	*1*	*1-1,5*	-	-	-	-	-	x	x	-	-	-	x	x	-
K2	*192/72*	*17*	*3-40*	*0,25*	*0,2-0,4*	*1,5*	*1-2*	*1*	*1-1,5*	*w1*	*w1-w2*	*29*	*22-38*	*1*	*1-1*	*VII*	*8*	*6-8*	*1*	*1-1*	-	-	-	-	-	x	x	-	-	-	x	x	-
K3	*145/72*	*55*	*30-70*	*0,5*	*0,07-0,9*	*3*	*3-3*	*2*	*1-3*	*w2*	*w1-w3*	*18*	*19-17*	*1.5*	*1-1,5*	*VII*	*6,5*	*4-10*	*1*	*1-1,5*	-	-	-	-	-	x	x	-	-	-	x	x	-

Rilievo di dettaglio delle discontinuità

RILIEVO GEOMECCANICO N°1

n°	set	giacitura		spaziatura	terminazione	persistenza lineare	apertura	alterazione		JCS			rugosità				riempimento	
								Barton / Cai	ISRM				Barton / Cai	Cai	ISRM			
		imm.[°]	incl. [°]	[cm]	[x-d-r]	[cm]	[mm]	Ja	[w1-w5]	R	α	[MPa]	Js	Jw	[I-IX]	JRC	tipo	[mm]
1	S0	332	14	7	d-d	20	-	1	w2	-	-	-	1,5	1,5	V	9	-	-
2	S0	312	5	40	x-x	180	3	1,5	w2	-	-	-	1,5	1	VII	8	sabbia,limo	3
3	S0	352	12	4	d-d	5	-	1	w1	-	-	-	1,5	1,5	V	9	-	-
4	S0	350	10	5	d-d	7	-	1	w1	-	-	-	1,5	1,5	V	10	-	-
5	S0	346	8	6	d-d	10	-	1	w1	-	-	-	1,5	1	V	8	-	-
6	S0	0	25	2	d-d	12	-	1	w2	-	-	-	1	1	V	8	-	-
7	S0	10	3	2	d-x	30	-	1	w1	-	-	-	1	1	VII	7	-	-
8	S0	16	5	5	x-d	25	-	1	w1	-	-	-	1,5	1,5	V	8	-	-
9	S0	15	5	1	d-d	8	-	1	w1	12	85	12	1,5	1,5	V	11	-	-
10	S0	330	10	8	d-d	15	-	1	w2	-	-	-	1,5	1,5	IV	10	-	-
11	S0	22	15	2	d-d	13	-	1	w1	12	75	12	1,5	1,5	V	9	-	-
12	S0	350	10	2	d-d	6	-	1	w1	-	-	-	1	1,5	V	10	-	-
13	S0	4	13	2	d-x	15	-	1	w1	-	-	-	1	1,5	V	10	-	-
14	S0	20	25	4	d-d	30	-	1,5	w2	-	-	-	1	1,5	V	12	-	-
15	S0	340	10	4	d-x	10	-	1	w1	-	-	-	1.5	1	VII	6	-	-
16	S0	344	8	9	d-d	12	-	1	w1	-	-	-	1	1	VII	7	-	-
17	S0	184	5	10	x-x	140	-	1	w1	11	85	11	1	1	VII	8	-	-
18	S0	2	5	3	d-d	2	1	1	w1	-	-	-	1	1	VII	6	-	-
19	S0	0	18	7	d-d	15	2	1,5	w2	-	-	-	1,5	1,5	V	12	sabbia,limo	1
20	S0	12	5	4	d-d	5	-	1	w1	12	85	12	1,5	1	VII	7	-	-
21	S0	17	4	2	d-d	2	-	1	w1	-	-	-	1	1	VII	7	-	-
22	S0	55	15	3	d-d	5	-	1,5	w2	-	-	-	1	1	V	8	-	-
23	S0	15	8	4	d-d	20	-	1	w1	-	-	-	1,5	1	VII	7	-	-
24	S0	17	4	2	d-d	10	1	1	w1	14	86	13	1	1.5	V	10	sabbia,limo	1
25	S0	0	10	7	d-d	8	-	1,5	w2	-	-	-	1,5	1	VII	8	-	-
26	k1	141	35	10	d-d	10	-	1	w1	-	-	-	1	1	VII	8	-	-
27	k1	110	60	15	d-x	150	-	2	w2	-	-	-	1	1,5	V	9	-	-
28	k1	90	60	3	x-x	60	-	1	w1	12	30	13	1,5	1,5	V	9	-	-
29	k1	80	62	10	r-d	80	-	1,5	w2	-	-	-	1,5	1,5	V	10	-	-
30	k1	112	20	4	x-x	25	-	1	w1	-	-	-	1	1	VII	7	-	-
31	k1	115	25	3	x-r	20	-	1	w1	11	65	13	1	1	VII	6	-	-
32	k1	116	25	5	x-x	80	2	1,5	w1	-	-	-	1,5	1	VII	6	sabbia,limo	2
33	k1	102	45	4	d-x	70	-	1,5	w2	-	-	-	1,5	1	VII	6	-	-
34	k1	104	55	20	x-x	50	-	1,5	w2	-	-	-	1,5	1	VII	6	-	-
35	k1	110	75	5	r-x	15	-	1	w1	18	15	22	1,5	1	IV	8	-	-
36	k1	114	40	5	1	60	-	1,5	w2	-	-	-	1,5	1	IV	10	-	-
37	k1	100	50	3	1	60	-	1	w1	12	40	13	1,5	1	VII	6	-	-
38	k1	102	70	2	x-r	20	-	1	w1	11	20	15	1	1	VII	8	-	-
39	k1	106	35	5	d-x	35	-	1,5	w2	-	-	-	1,5	1	V	9	-	-
40	k2	195	70	40	d-d	40	-	1	w1	22	20	28	1	1	VII	8	-	-
41	k2	190	70	20	2	35	2	1	w1	18	20	22	1	1	VII	8	sabbia,limo	2
42	k2	172	60	3	2	5	1	1	w1	30	30	38	1	1	VII	6	sabbia,limo	1
43	k2	190	75	5	d-d	2	-	1,5	w2	-	-	-	1	1	VII	8	-	-
44	k3	148	70	70	x-x	90	-	3	w3	-	-	-	1	1	VII	4	-	-
45	k3	146	75	60	d-x	7	-	1	w1	-	-	-	1	1,5	IV	10	-	-
46	k3	140	80	30	d-d	90	3	1,5	w3	15	10	19	1	1	VII	6	sabbia,limo	3
47	k3	145	65	60	r-d	15	-	2	w2	16	25	17	1,5	1	VII	6	-	-
48	k	40	40	-	d-d	5	-	1	w1	-	-	-	1	1	VII	7	-	-
49	k	255	80	-	d-x	10	-	1,5	w2	22	10	28	1	1	VII	7	-	-
50	k	264	82	-	d-x	40	-	1,5	w2	-	-	-	1,5	1	VII	8	-	-

RILIEVO GEOMECCANICO N°1

Classificazione geomeccanica

Committente	*SPEA ENGINEERING SPA*
Commessa	*A1 Incisa Valdarno (Progetto esecutivo terza corsia)*
Località	*Regello (FI)*
Data	*16/05/2018*
Coordinate:	*Gauss Boaga X: 1698002 Y: 4838408*
Quota:	*155 m*
Area di rilievo geomeccanico	*Versante imbocco Sud galleria Bruscheto (a ridosso della rete di consolidamento)*

Parametri del materiale roccia		*minimo*	*moda*	*massimo*	*Punteggio RMR*
resistenza a compressione monoassiale	σ_{ci} *[MPa]*	*14*	*46*	*60*	*4*
parametro dell'inviluppo di rottura	m_i *[-]*	*12*	*12*	*12*	

Parametri d'ammasso		*minimo*	*moda*	*massimo*	
Joint set number - Jn		*9*	*12*	*12*	
Numero di discontinuità per metro cubo d'ammasso - J_v	*[n°/m³]*	*25*	*35*	*50*	
Rock Quality Designation RQD	*[%]*	*4*	*14*	*29*	*2*
Spaziatura delle discontinuità	*[cm]*	*1,0*	*2*	*80*	*5*
Condizioni delle discontinuità:					
lunghezza	*[m]*	*0,0*	*0,15*	*1,8*	*6*
apertura	*[mm]*	*1,0*	*2*	*3*	*1*
rugosità:					
JRC	*[-]*				*3*
Js	*[-]*	*1,00*	*1,00*	*1,5*	
Jw	*[-]*	*1,00*	*1,00*	*1,5*	
riempimento:					
tipo	*[-]*	*tenero*			
spessore	*[mm]*	*1,0*	*2,0*	*3,0*	*2*
alterazione:					
	[%]	*10*	*20*	*45*	*5*
Ja	*[-]*	*1*	*1*	*3*	
condizioni di umidità		*umido*			*10*

RMR	***38***

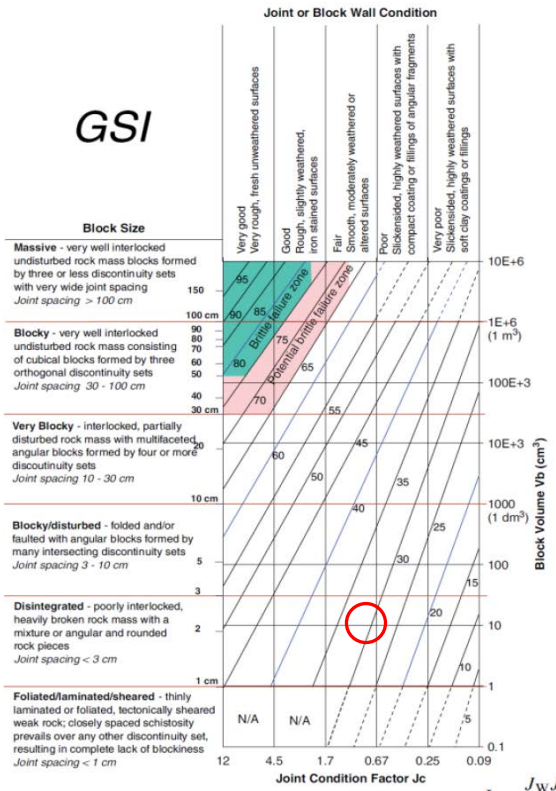
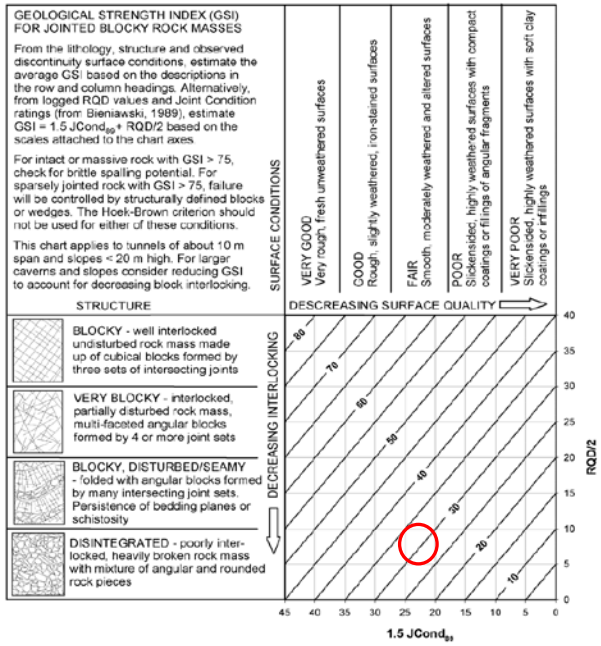


Fig. 5. Quantification of GSI chart [2].

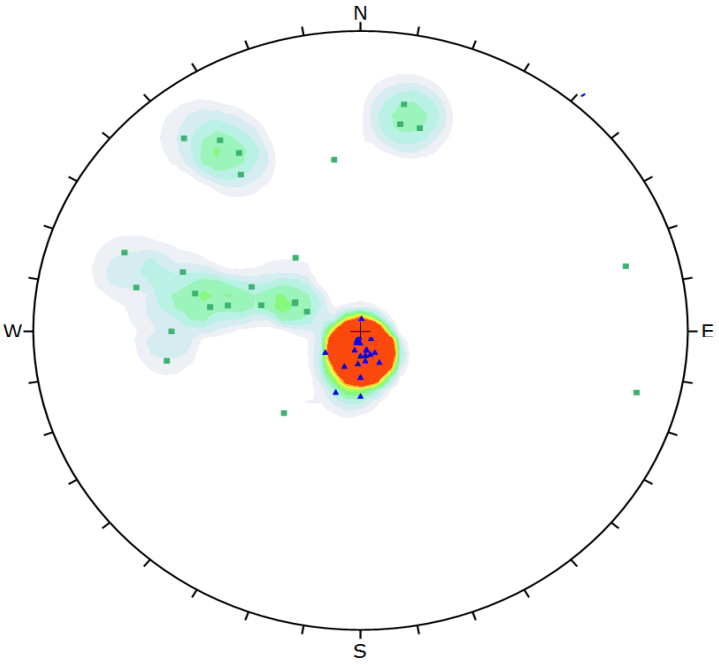
$$J_c = \frac{J_W J_S}{J_A},$$



Vb (cm3)	10
Jc	1

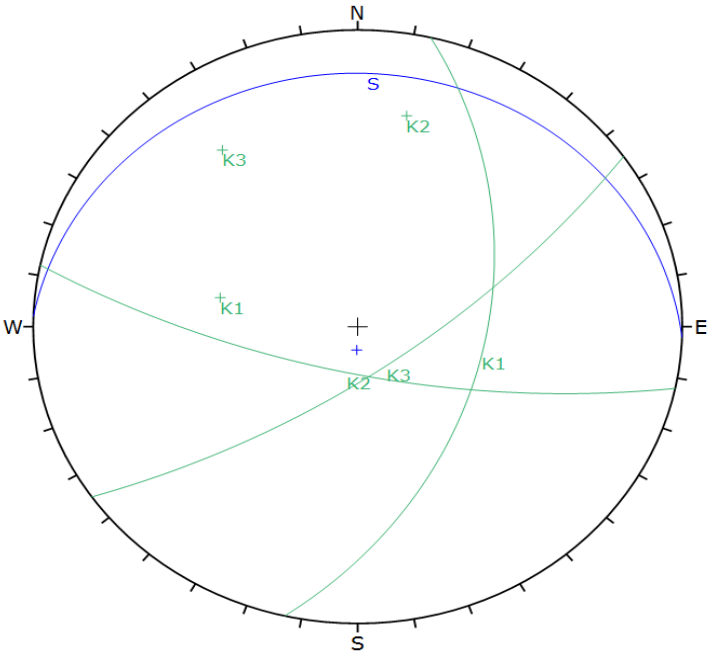
GSI	***32***

ALLEGATI RILIEVO GEOMECCANICO N. 1 - Bruscheto Sud



Symbol	EXTRA1	Quantity
▲	S0	25
■	k	25

Plot Mode	Pole Vectors
Vector Count	50 (50 Entries)
Hemisphere	Lower
Projection	Equal Angle

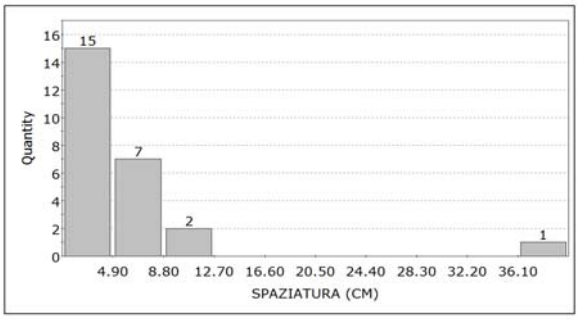


	Color	Dip	Dip Direction	Label
Mean Set Planes				
1m		9	2	S
2m		47	103	K1
3m		72	192	K2
4m		72	145	K3

Plot Mode	Pole Vectors
Vector Count	50 (50 Entries)
Hemisphere	Lower
Projection	Equal Angle

SET STRATIFICAZIONE

SPAZIATURA (CM)



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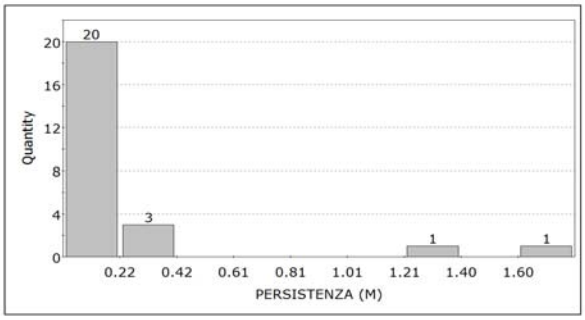
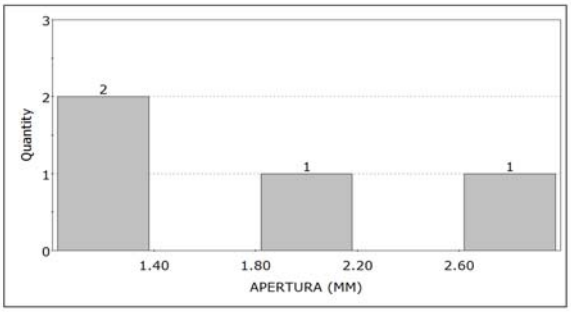
PERSISTENZA (M)



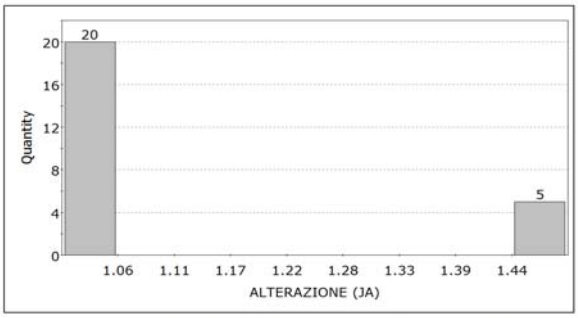
mean=0.242 s.d.=0.419881 min=0.02 max=1.8

APERTURA (MM)



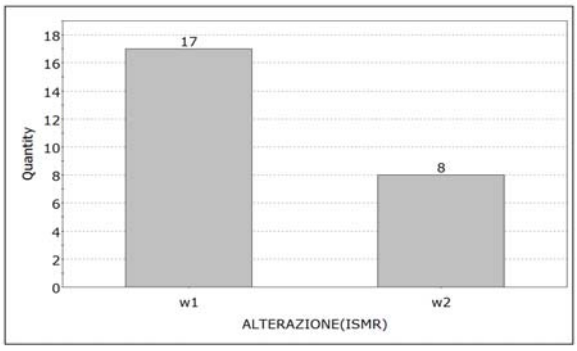
mean=1.75 s.d.=0.957427 min=1 max=3

ALTERAZIONE (JA)

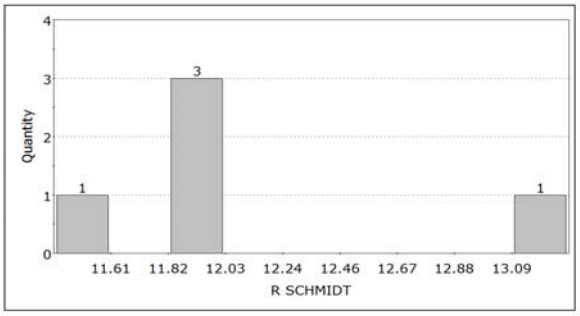


mean=1.1 s.d.=0.204124 min=1 max=1.5

ALTERAZIONE(ISMR)



R SCHMIDT



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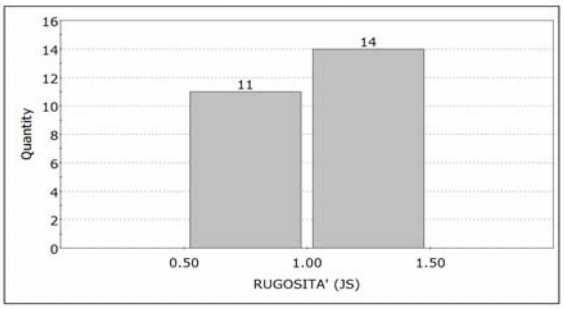
RUGOSITA' (JS)



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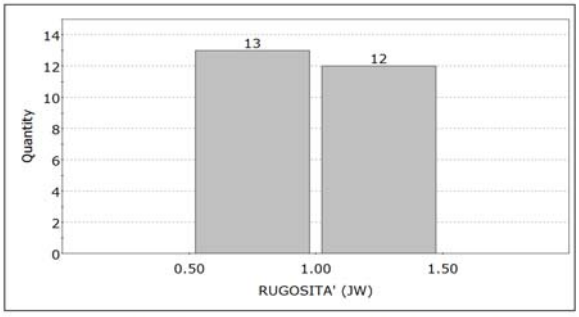
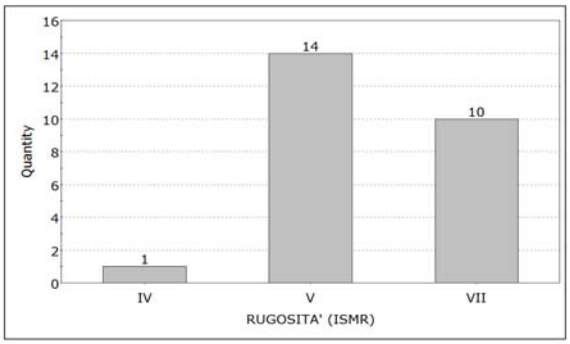
RUGOSITA' (JW)

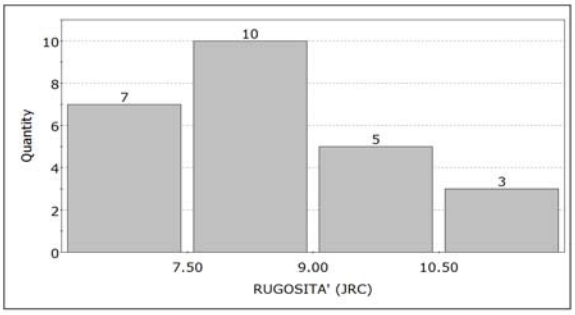


mean=1.24 s.d.=0.254951 min=1 max=1.5

RUGOSITA' (ISMR)



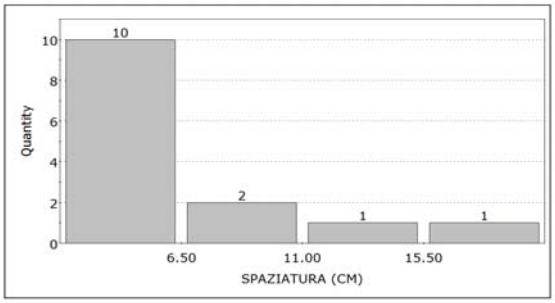
RUGOSITA' (JRC)



mean=8.6 s.d.=1.68325 min=6 max=12

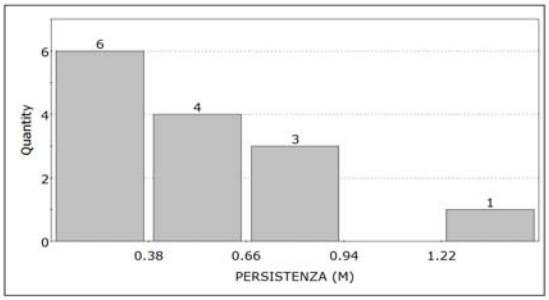
SET K1

SPAZIATURA (CM)



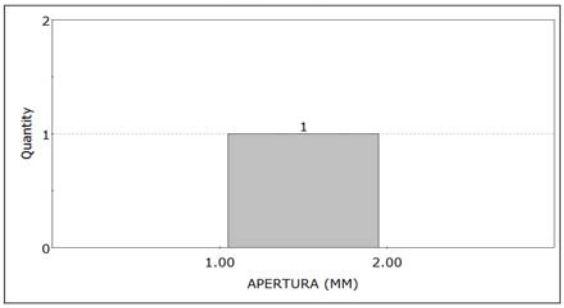
mean=6.71429 s.d.=5.23933 min=2 max=20

PERSISTENZA (M)



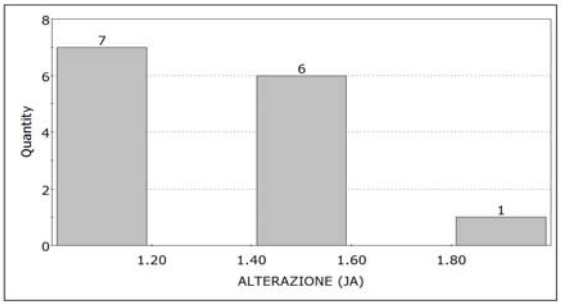
mean=0.525 s.d.=0.37094 min=0.1 max=1.5

APERTURA (MM)



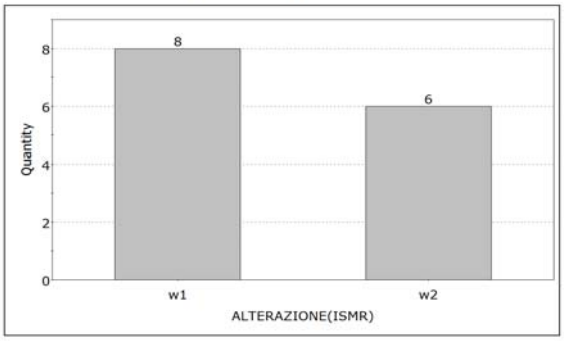
mean=2 s.d.=0 min=2 max=2

ALTERAZIONE (JA)

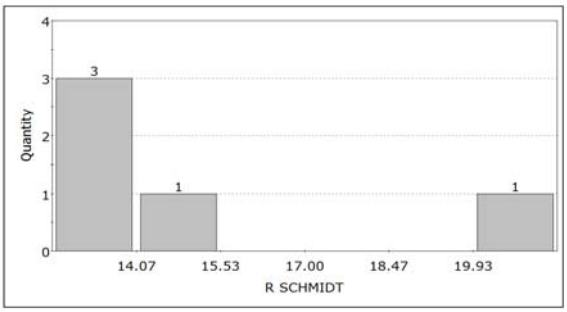


mean=1.28571 s.d.=0.323103 min=1 max=2

ALTERAZIONE(ISMR)

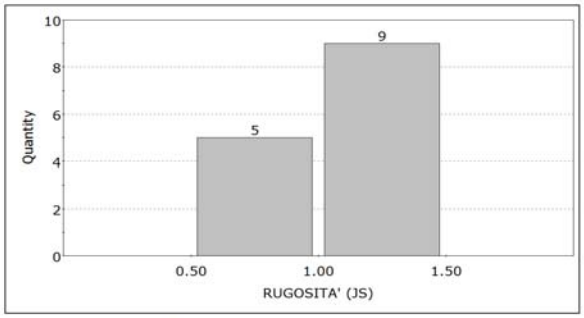


R SCHMIDT



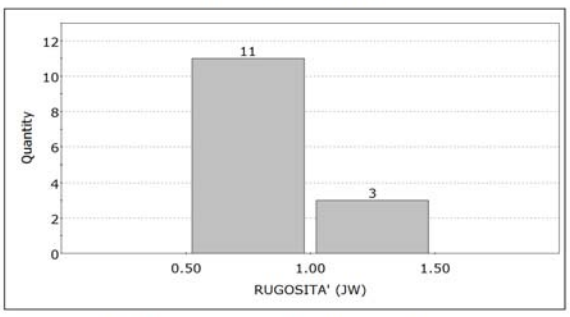
mean=15.0899 s.d.=3.6395 min=12.6 max=21.4

RUGOSITA' (JS)

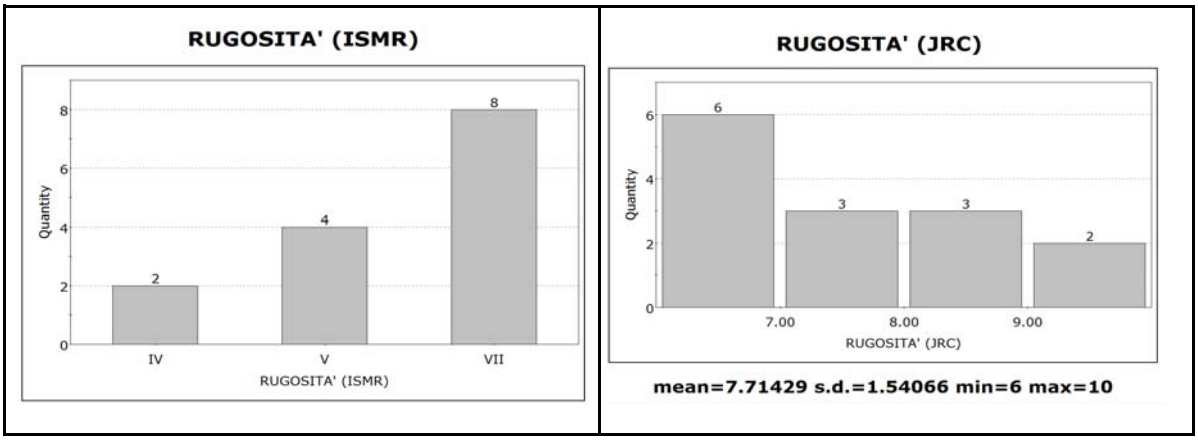


mean=1.32143 s.d.=0.248623 min=1 max=1.5

RUGOSITA' (JW)

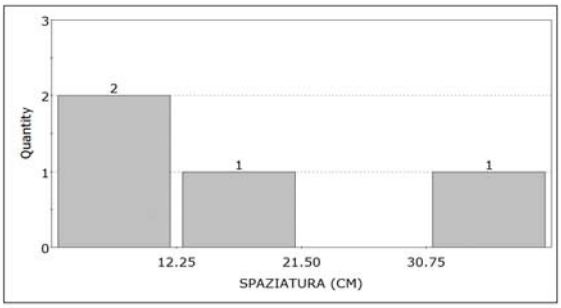


mean=1.10714 s.d.=0.212908 min=1 max=1.5


RUGOSITA' (ISMR)
Quantity
0
2
4
6
8
2
4
8
IV
V
VII
RUGOSITA' (ISMR)
RUGOSITA' (JRC)
Quantity
0
2
4
6
6
3
3
2
7.00
8.00
9.00
RUGOSITA' (JRC)
mean=7.71429 s.d.=1.54066 min=6 max=10

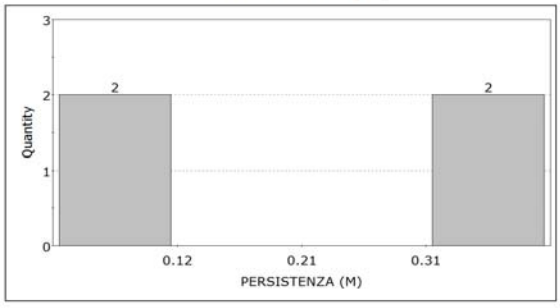
SET K2

SPAZIATURA (CM)



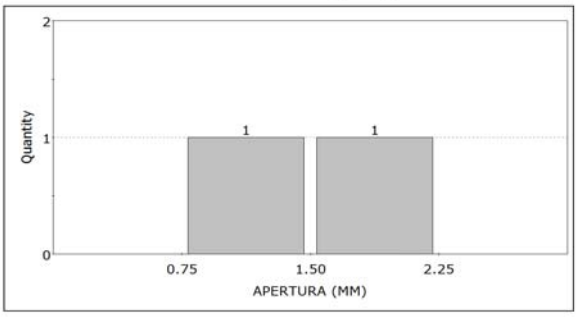
mean=17 s.d.=17.1075 min=3 max=40

PERSISTENZA (M)



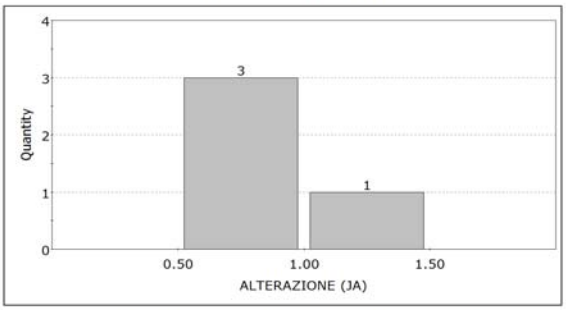
mean=0.205 s.d.=0.197737 min=0.02 max=0.4

APERTURA (MM)



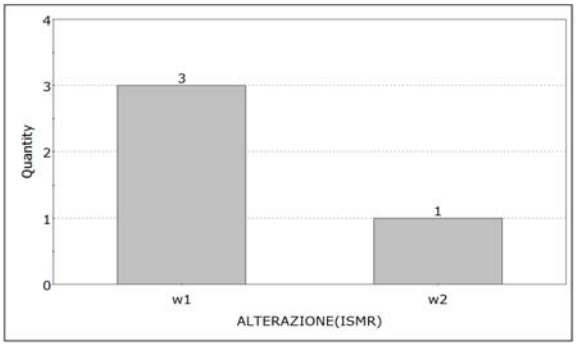
mean=1.5 s.d.=0.707107 min=1 max=2

ALTERAZIONE (JA)

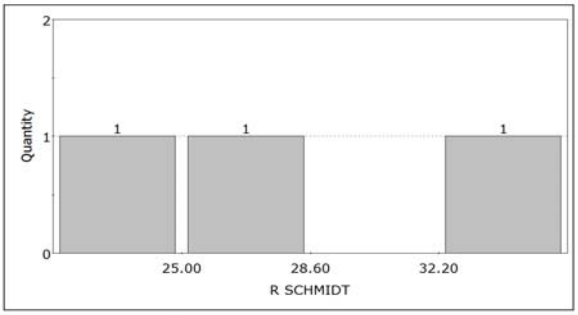


mean=1.125 s.d.=0.25 min=1 max=1.5

ALTERAZIONE(ISMR)

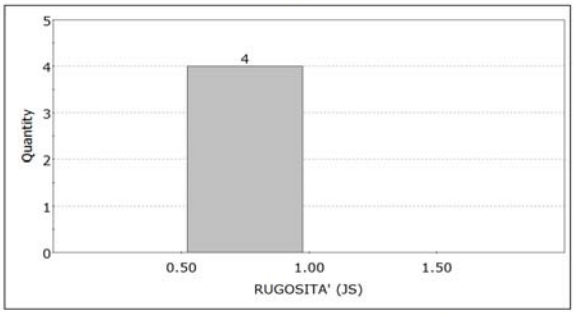


R SCHMIDT



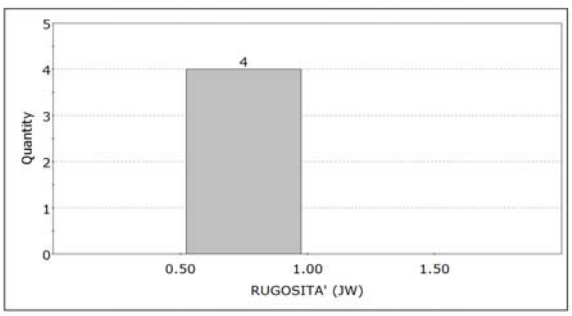
mean=27.9667 s.d.=7.28309 min=21.4 max=35.8

RUGOSITA' (JS)



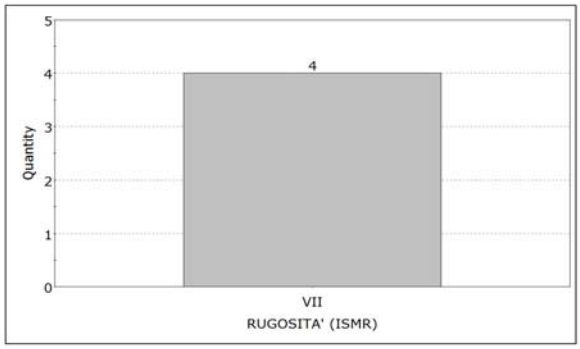
mean=1 s.d.=0 min=1 max=1

RUGOSITA' (JW)

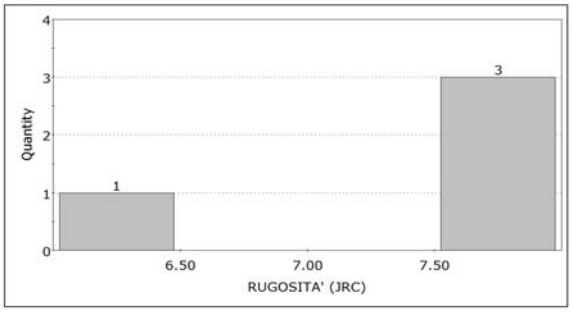


mean=1 s.d.=0 min=1 max=1

RUGOSITA' (ISMR)



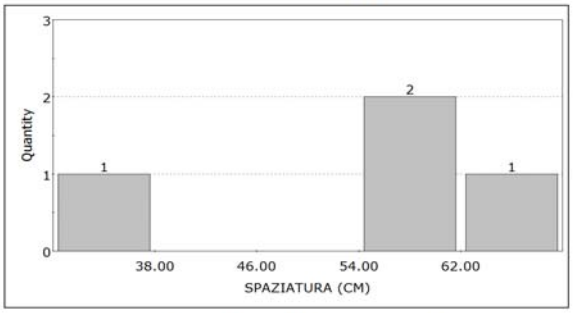
RUGOSITA' (JRC)



mean=7.5 s.d.=1 min=6 max=8

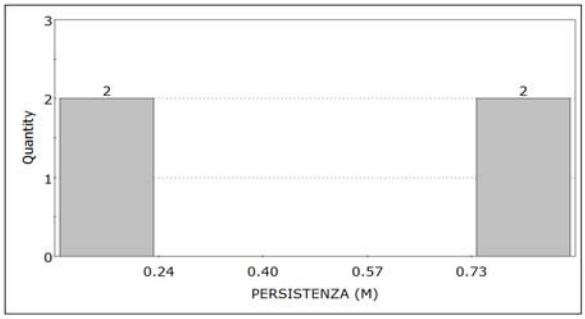
SET K3

SPAZIATURA (CM)



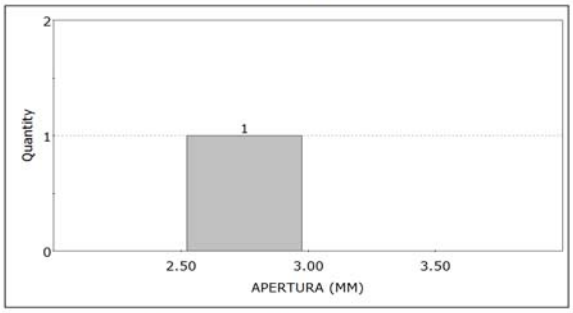
mean=55 s.d.=17.3205 min=30 max=70

PERSISTENZA (M)



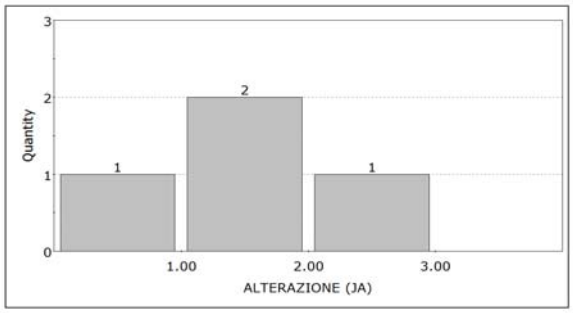
mean=0.505 s.d.=0.457275 min=0.07 max=0.9

APERTURA (MM)



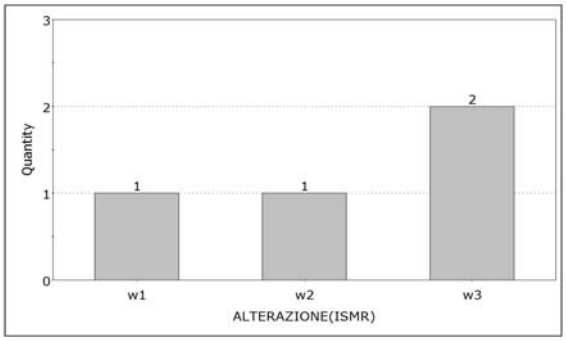
mean=3 s.d.=0 min=3 max=3

ALTERAZIONE (JA)

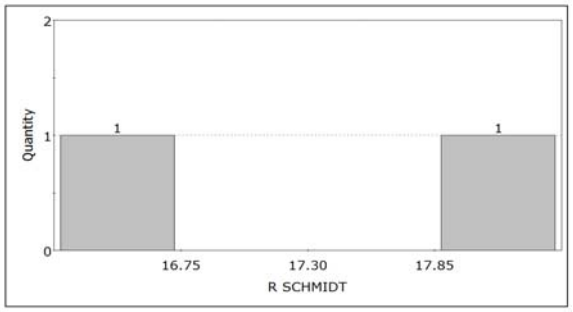


mean=1.875 s.d.=0.853913 min=1 max=3

ALTERAZIONE(ISMR)

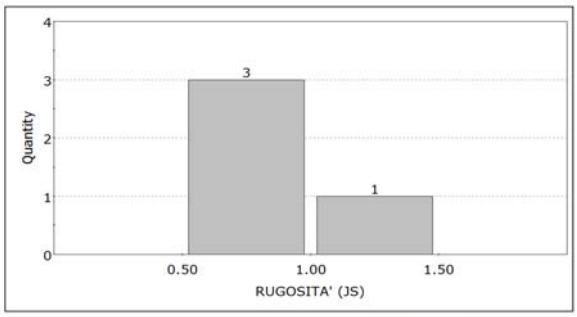


R SCHMIDT



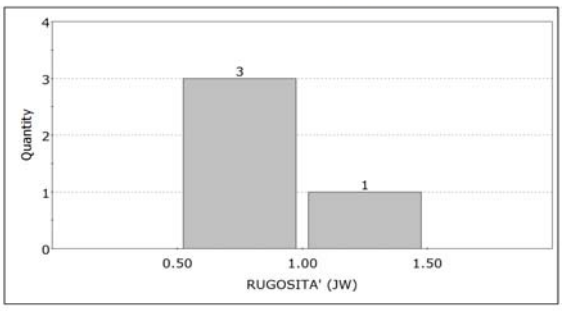
mean=17.3 s.d.=1.55563 min=16.2 max=18.4

RUGOSITA' (JS)



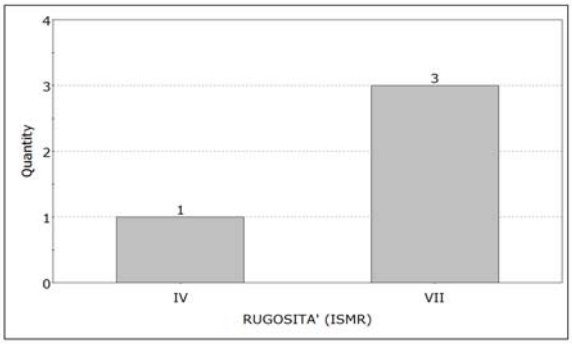
mean=1.125 s.d.=0.25 min=1 max=1.5

RUGOSITA' (JW)

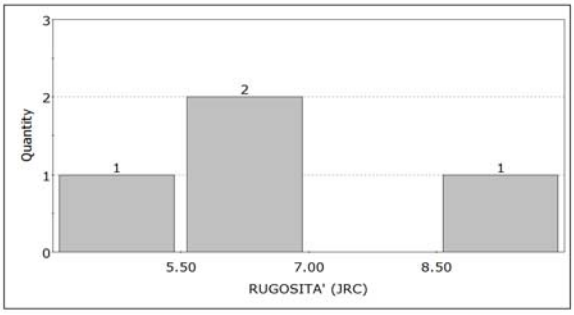


mean=1.125 s.d.=0.25 min=1 max=1.5

RUGOSITA' (ISMR)



RUGOSITA' (JRC)

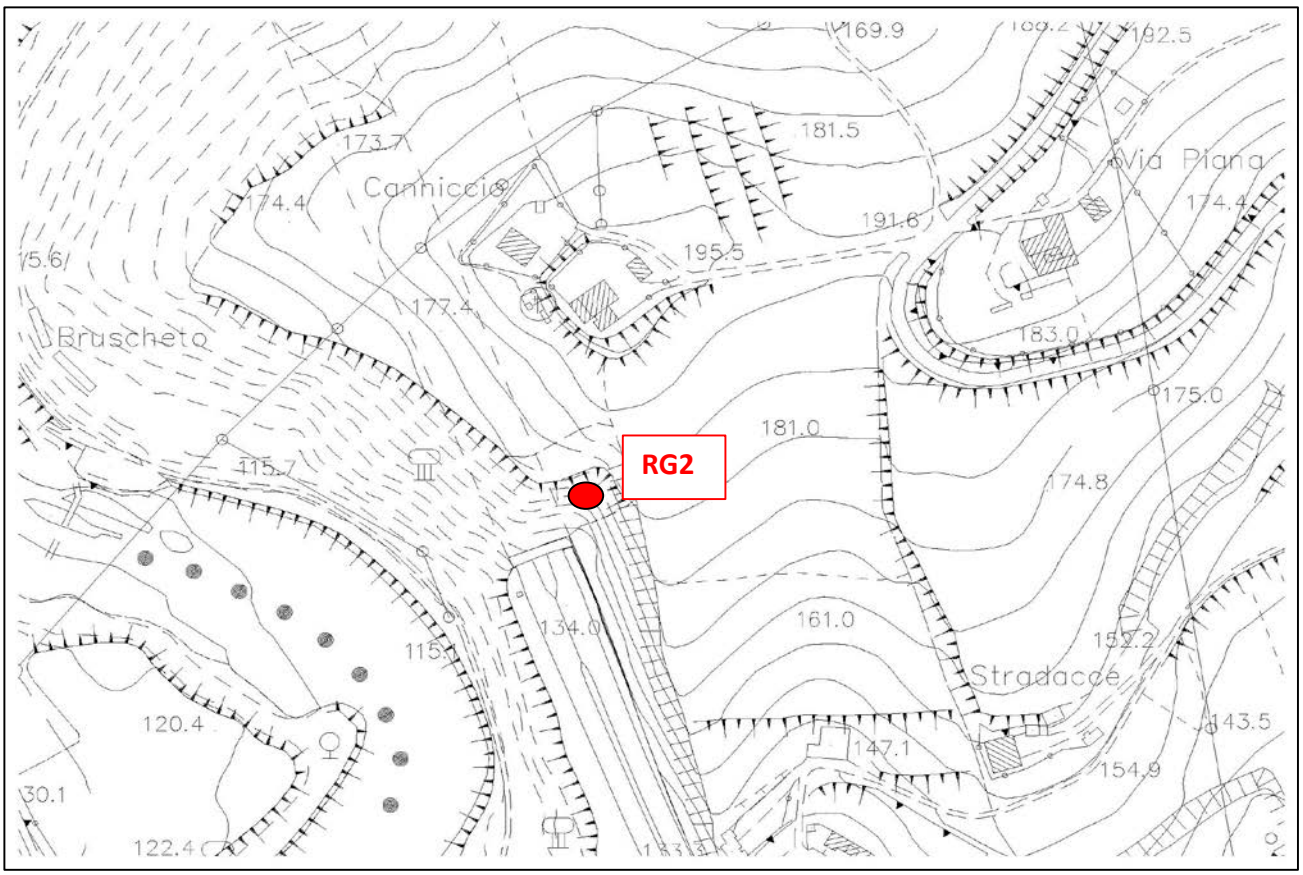


mean=6.5 s.d.=2.51661 min=4 max=10

RILIEVO GEOMECCANICO N°2
Ubicazione area di rilievo

Committente	*SPEA ENGINEERING SPA*			
Commessa	*A1 Incisa Valdarno (Progetto esecutivo terza corsia)*			
Località	*Reggello (FI)*			
Coordinate	*Gauss Boaga*	*X: 1698002*	*Y: 4838408*	*Quota: 165 m*
Data	*9 e 16/05/2018*			
Area di rilievo geomeccanico	*Versante imbocco Sud galleria Bruscheto*			

Stralcio planimetrico



RILIEVO GEOMECCANICO N°2
Scheda di sintesi

Committente	SPEA-AUTOSTRADE
Commessa	A1 Incisa Valdarno (Progetto esecutivo terza corsia)
Località	Reggello (FI)
Coordinate	Gauss Boaga X: 1698002 Y: 4838408 Quota: 165 m
Data	9 e 16/05/2018
Area di rilievo geomeccanico	Versante imbocco Sud galleria Bruscheto

Condizioni generali dell'ammasso roccioso

Giacitura del fronte di misura		[°/°]	168/75°	
Giacitura generale del pendio		[°/°]	180/45°	
Dimensioni dell'area di rilievo geomeccanico		[m x m]	1x3.8	
Volume roccioso unitario medio	[minimo]	[cm x cm x cm]	4x2x1	
medio 5x4x3	[massimo]	[cm x cm x cm]	40x20x10	
	[forma]	[-]	paralllepipedo	
Resistenza a compressione monoassiale del materiale roccia:		litologia	Calcare marnoso	
		moda [MPa]	46	
		variabilità [MPa]	14-60	
Intercetta delle discontinuità		[n°/m]	18	valori modali
Numero di discontinuità per metro cubo d'ammasso - J_v		[n°/m^3]	30	

Grado di alterazione dell'ammasso	non alterato	debolm. alterato	moder. alterato	molto alterato	decom-posto
		X	X		
Condizioni di umidità dell'ammasso	asciutto	umido	bagnato	stillicidio	flusso
		X			

Geological Strength Index

Struttura in ammassi omogenei	I	B	VB	B/D/S	D	L/S
				X	x	
Condizioni delle discontinuità	VG	G	F	P	VP	
				X		

GSI 28

Litologia e descrizione geologica generale

Calcare da debolmente marnoso a marnoso colore grigio chiaro, avana; a tratti presenta patina arancione di alterazione, in percentuale maggiore rispetto a RG1.
Alla base affiora uno strato calcarenitico di 20 cm di spessore fittamente stratificato più resistente del restante ammasso.
L' affioramento da debolmente a moderatamente alterato presenta fratture aperte fino a 15 cm, nella parte centrale si nota una porzione basculata, le misurazioni relative a questa porzione sono state filtrate nell' elaborazione dei dati acquisiti sul terreno.

Condizioni generali delle discontinuità

set	giacitura [°/°]	spaziatura [cm]		persistenza [m]		apertura [mm]		ALTERAZIONE Ja [-]		ALTERAZIONE ISRM [W1-W5]	RESISTENZA JCS [MPa]		Js [-]		RUGOSITA' ISRM [I-IX]	RUGOSITA' JRC [-]		RUGOSITA' Jw [-]		pellicole materiale prevalente			riempimento materiale prevalente							durezza		spessore [mm]	
		media	variabilità	media	variabilità	media	variabilità	media	variabilità	moda	media	variabilità	media	variabilità	moda	media	variabilità	media	variabilità	sabbia	limo	argilla	minerali asbestiformi	vene minerali	sabbia	limo	argilla	scaglie e arg.	mat. rigonf.	duro	tenero	< 5	> 5
S0	59/7	6.6	1-25	1	0.10-2.5	3	1-5	1.3	1-1.5	w2	14	11-22	1.2	1-1.5	VII	7	4-10	1.2	1-1.5	-	-	-	-	-	x	x	-	-	-	-	x	x	
K1	161/72	29	4-150	0.62	0.01-1.2	54	2-150	2.1	1.5-3	w2	20	16-34	1.2	1-1.5	VIII	7	6-11	1.2	1-1.5	-	-	-	-	-	x	x	-	-	-	-	x	x	x
K2	309/75	9	4-20	0.58	0.1-0.9	11	3-30	1.9	1.5-3	w2	25	15-31	1	1-1	VII	8	6-12	1.1	1-1.5	-	-	-	-	-	x	x	-	-	-	-	x	x	x
K3	22/76	14	8-30	0.46	0.2-0.6	53	6-100	2	2-2	w2	-	-	1.5	1.5-1.5	VII	8	8-8	1	1-1	-	-	-	-	-	x	x	-	-	-	-	x		x
K4	268/83	8	5-10	0.43	0.2-0.8	8	5-12	2.33	2-3	w2	22	-	1.2	1-1.5	V	8	7-10	1.2	1-1.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Rilievo di dettaglio delle discontinuità

RILIEVO GEOMECCANICO N°2

n°	set	giacitura		spaziatura	terminazione	persistenza lineare	apertura	alterazione		JCS			rugosità				riempimento	
								Barton / Cai	ISRM				Barton / Cai	Cai	ISRM			
		imm.[°]	incl. [°]	[cm]	[x-d-r]	[cm]	[mm]	Ja	[w1-w5]	R	α	[MPa]	Js	Jw	[I-IX]	JRC	tipo	[mm]
1	S0	55	5	2	d-d	200	-	1	w2	16	85	15	1	1.5	V	8	-	-
2	S0	135	15	3	x-d	150	-	1	w2	-	-	-	1	1.5	V	9	-	-
3	S0	186	12	1	d-d	230	-	1	w2	14	78	13	1	1.5	V	8	-	-
4	S0	98	15	1	x-d	250	-	1.5	w2	-	-	-	1	1.5	V	8	-	-
5	S0	60	25	2	x-x	200	-	1.5	w2	18	65	18	1	1.5	V	10	-	-
6	S0	40	12	3	d-x	150	-	1.5	w2	-	-	-	1.5	1	VII	4	-	-
7	S0	80	15	5	d-d	40	1	1.5	w2	-	-	-	1.5	1	VII	6	-	-
8	S0	75	10	25	d-x	50	2	1	w2	14	80	13	1.5	1	VII	4	-	-
9	S0	45	10	10	x-d	40	-	1	w2	16	80	15	1.5	1	VII	8	-	-
10	S0	50	30	5	d-x	50	3	1.5	w2	6	60	12	1.5	1	VII	6	sabbia,limo	3
11	S0	96	15	20	d-d	60	-	1.5	w2	-	-	-	1.5	1	VII	6	-	-
12	S0	112	15	15	d-d	30	-	1	w2	22	75	22	1.5	1	VII	6	-	-
13	S0	60	30	12	d-d	40	-	1.5	w2	-	-	-	1.5	1	VII	6	-	-
14	S0	72	15	10	d-x	10	-	1.5	w2	12	75	12	1.5	1	VII	7	-	-
15	S0	106	8	1	d-x	150	4	1.5	w2	12	82	12	1	1.5	V	8	sabbia,limo	4
16	S0	135	15	1	r-d	200	5	1.5	w2	11	75	11	1	1.5	V	9	sabbia,limo	5
17	S0	60	5	5	d-d	30	-	1.5	w2	12	85	12	1	1.5	V	9	-	-
18	S0	90	10	3	d-d	40	-	1.5	w2	-	-	-	1	1	VIII	7	-	-
19	S0	90	10	2	d-d	150	-	1.5	w2	-	-	-	1	1	VIII	6	-	-
20	k1	118	85	5	d-d	80	-	1.5	w2	-	-	-	1	1	VIII	8	-	-
21	k1	172	55	20	x-x	70	-	2	w2	-	-	-	1	1	VIII	8	-	-
22	k1	184	73	150	x-x	50	50	2	w2	14	17	18	1	1	VIII	8	-	-
23	k1	182	75	15	d-d	10	2	2	w3	26	15	34	1	1	VIII	8	-	-
24	k1	133	80	5	d-d	20	-	2	w3	12	10	16	1	1	VIII	8	-	-
25	k1	178	82	5	r-r	80	-	2	w2	12	8	16	1.5	1	VII	8	-	-
26	k1	174	82	30	r-d	20	-	2	w2	-	-	-	1.5	1	VII	6	-	-
27	k1	134	65	20	d-r	100	15	3	w3	-	-	-	1.5	1	VII	7	sabbia,limo	15
28	k1	182	65	10	d-r	120	-	3	w3	-	-	-	1.5	1	VII	7	-	-
29	k1	170	80	5	d-d	80	-	2	w3	-	-	-	1.5	1	VII	6	-	-
30	k1	153	65	4	d-d	75	-	2	w2	-	-	-	1	1	VIII	6	-	-
31	k1	148	75	80	d-d	40	150	1.5	w2	14	15	18	1	1.5	V	11	-	-
31	k2	312	85	5	x-x	60	30	1.5	w2	22	-5	28	1	1	VIII	7	-	-
32	k2	315	82	6	x-d	70	8	1.5	w2	22	-8	28	1	1	VIII	7	-	-
33	k2	298	70	4	d-x	10	3	1.5	w2	18	20	22	1	1	VIII	6	-	-
34	k2	318	85	5	d-x	50	-	2	w3	-	-	-	1	1	VII	8	-	-
35	k2	300	70	5	d-d	90	-	1.5	w2	24	20	31	1	1.5	V	12	-	-
36	k2	310	72	10	d-d	50	4	2	w2	11	18	15	1	1	VII	8	sabbia,limo	4
37	k2	303	70	15	d-d	70	8	3	w3	-	-	-	1	1	VII	8	sabbia,limo	8
38	k2	315	74	20	d-d	60	15	2	w2	-	-	-	1	1	VII	7	-	15
39	k3	28	75	10	x-d	60	100	2	w2	-	-	-	1.5	1	VII	8	sabbia,limo	80
40	k3	10	80	10	x-d	20	-	2	w2	-	-	-	1.5	1	VII	8	-	-
41	k3	22	75	30	d-d	50	6	2	w2	-	-	-	1.5	1	VII	8	sabbia,limo	6
42	k3	20	80	8	d-d	40	-	2	w2	-	-	-	1.5	1	VII	8	-	-
43	k3	30	70	10	d-d	60	-	2	w2	-	-	-	1.5	1	VII	8	-	-
44	k4	265	85	5	x-d	20	12	2	w2	-	-	-	1	1	V	7	-	-
45	k4	272	85	10	x-x	80	-	2	w2	-	-	-	1	1	V	8	-	-
46	k4	268	80	10	d-x	30	5	3	w3	18	10	22	1.5	1.5	V	10	-	-
47	k	190	40	-	x-d	50	-	2	w2	20	50	21	1.5	1	VII	8	-	-
48	k	224	82	-	d-x	35	-	2	w3	12	-8	16	1.5	1	VII	8	-	-
49	k	82	76	-	d-x	50	60	2	w3	10	-14	14	1.5	1	VII	6	-	-
50	k	200	85	-	d-r	85	15	2	w2	22	-5	10	1.5	1	VII	10	sabbia,limo	10

RILIEVO GEOMECCANICO N°2

Classificazione geomeccanica

Committente	*SPEA ENGINEERING SPA*
Commessa	*A1 Incisa Valdarno (Progetto esecutivo terza corsia)*
Località	*Reggello (FI)*
Data	*9 e 16/05/2018*
Coordinate:	*Gauss Boaga X: 1698002 Y: 4838408*
Quota:	*165 m*
Area di rilievo geomeccanico	*Versante imbocco Sud galleria Bruscheto*

Parametri del materiale roccia		*minimo*	*moda*	*massimo*	*Punteggio RMR*
resistenza a compressione monoassiale	σ_{ci} *[MPa]*	*14*	*46*	*60*	*4*
parametro dell'inviluppo di rottura	m_i *[-]*	*12*	*12*	*12*	

Parametri d'ammasso			*minimo*	*moda*	*massimo*	
Joint set number - Jn			*12*	*15*	*15*	
Numero di discontinuità per metro cubo d'ammasso - J_v		*[n°/m^3]*	*20*	*30*	*40*	
Rock Quality Designation RQD		*[%]*	*9*	*20*	*41*	*2*
Spaziatura delle discontinuità		*[cm]*	*1,0*	*5*	*150*	*7*
Condizioni delle discontinuità:						
	lunghezza	*[m]*	*0,0*	*0,5*	*2,5*	*5*
	apertura	*[mm]*	*1,0*	*15*	*150*	*0*
	rugosità:					
	JRC	*[-]*	*4*	*8*	*12*	*2*
	Js	*[-]*	*1,0*	*1,0*	*1,5*	
	Jw	*[-]*	*1,0*	*1,0*	*1,5*	
	riempimento:					
	tipo	*[-]*	*tenero*			
	spessore	*[mm]*	*1,0*	*15,0*	*150,0*	*0*
	alterazione:					
		[%]	*10*	*30*	*45*	*4*
	Ja	*[-]*	*1*	*2*	*3*	
	condizioni di umidità		*umido*			*10*

RMR	**34**

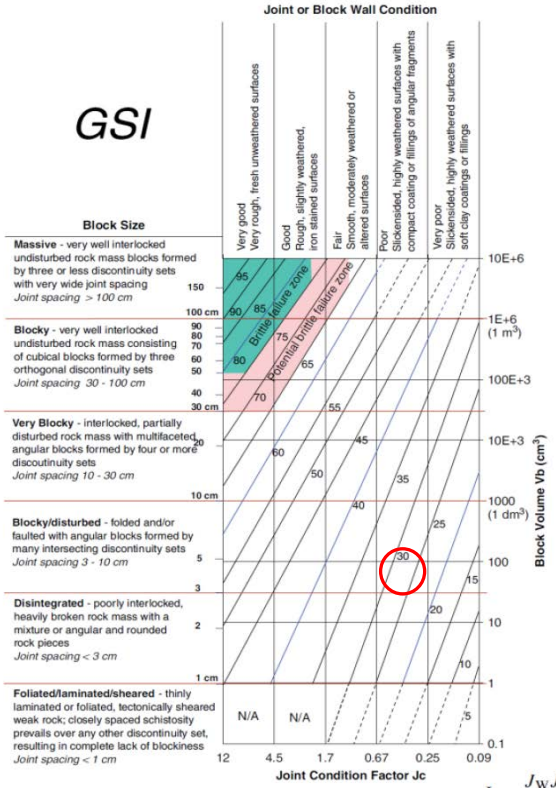
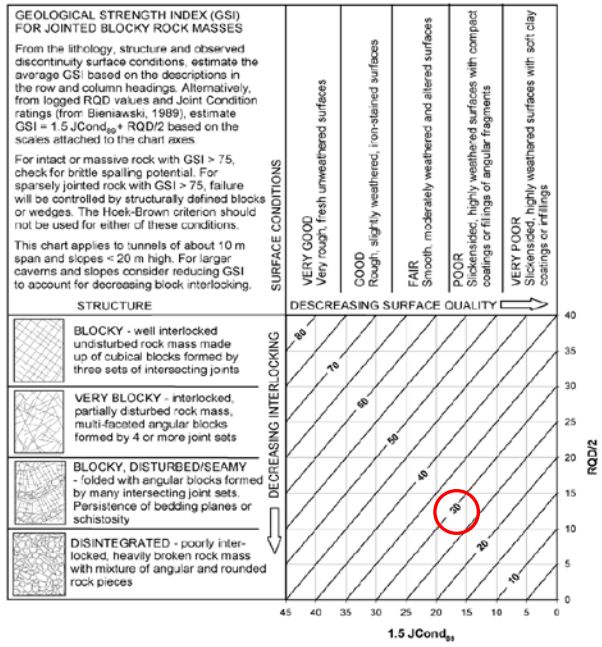


Fig. 5. Quantification of GSI chart [2].

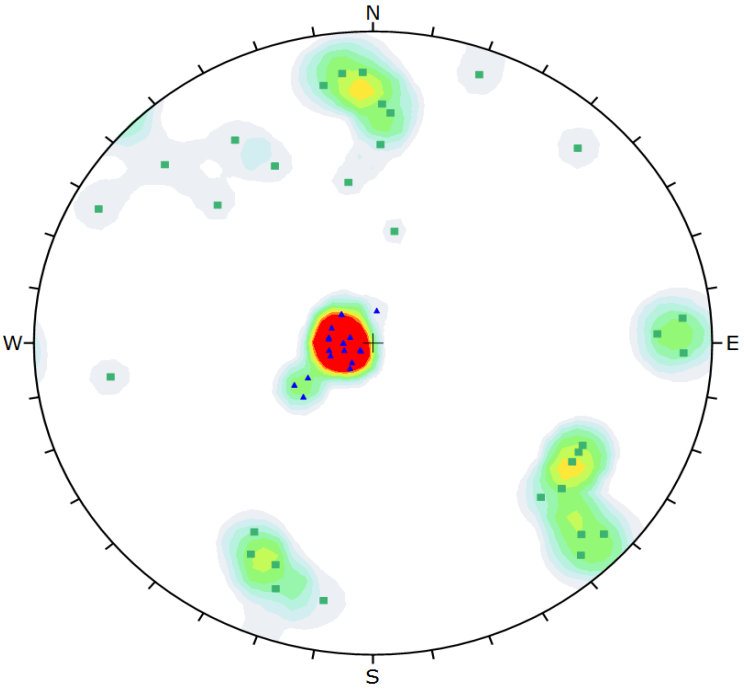
$$J_c = \frac{J_W J_S}{J_A},$$



Vb (cm3)	90
Jc	0,5

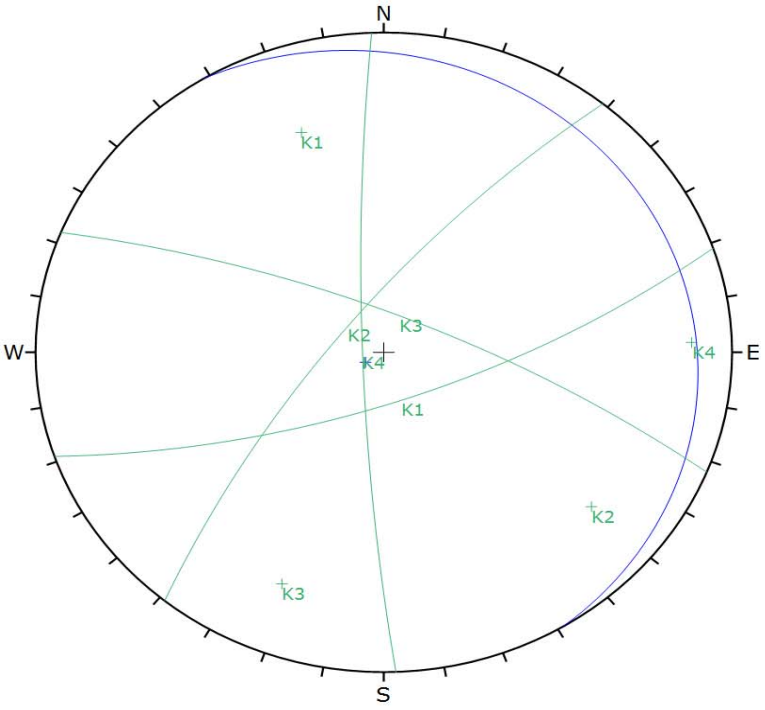
GSI	**28**

ALLEGATI RILIEVO GEOMECCANICO N. 2 - Bruscheto Sud



Symbol	SET	Quantity
▲	S0	19
■	k	32

Plot Mode	Pole Vectors
Vector Count	51 (51 Entries)
Hemisphere	Lower
Projection	Equal Angle

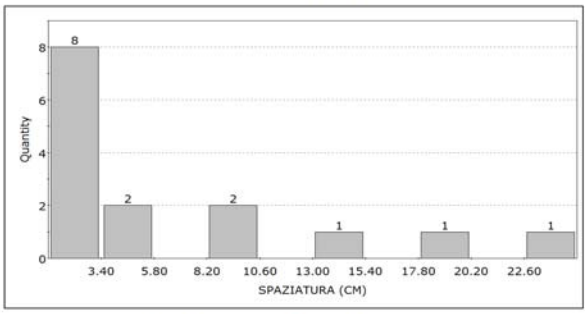


	Color	Dip	Dip Direction	Label
Mean Set Planes				
1m		7	59	
2m		72	161	K1
3m		75	309	K2
4m		76	22	K3
5m		83	268	K4

Plot Mode	Pole Vectors
Vector Count	51 (51 Entries)
Hemisphere	Lower
Projection	Equal Angle

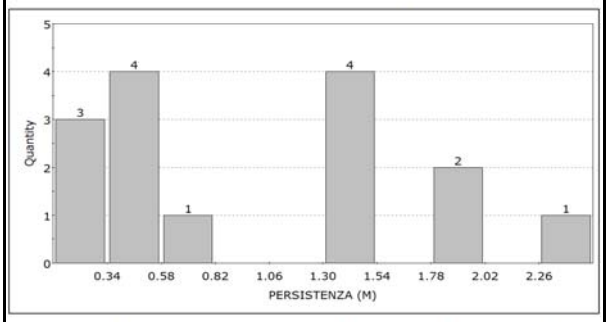
SET STRATIFICAZIONE

SPAZIATURA (CM)



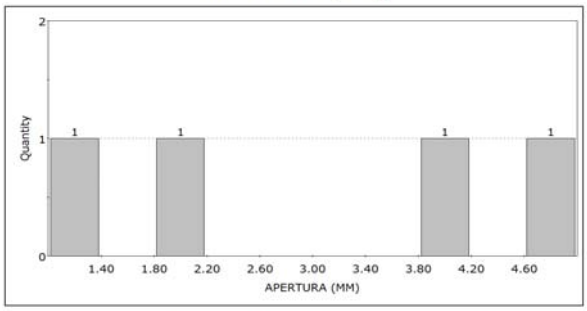
mean=7.06667 s.d.=7.50682 min=1 max=25

PERSISTENZA (M)



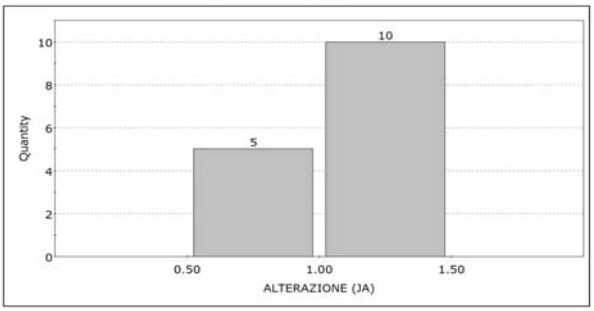
mean=1.03333 s.d.=0.779805 min=0.1 max=2.5

APERTURA (MM)



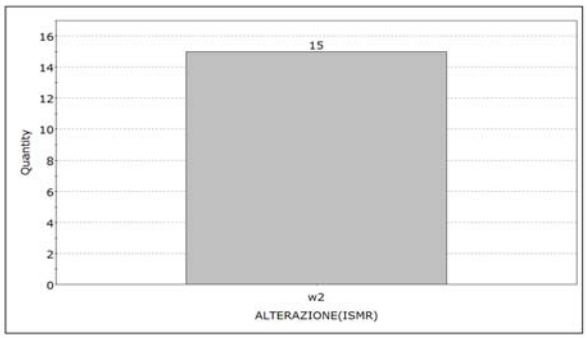
mean=3 s.d.=1.82574 min=1 max=5

ALTERAZIONE (JA)

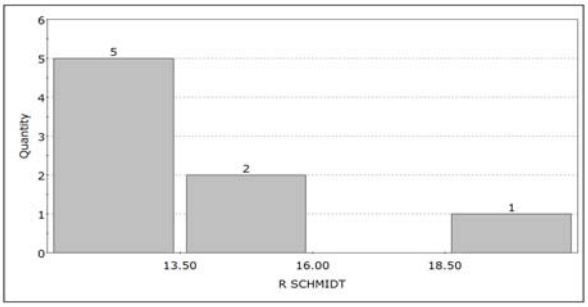


mean=1.33333 s.d.=0.243975 min=1 max=1.5

ALTERAZIONE(ISMR)

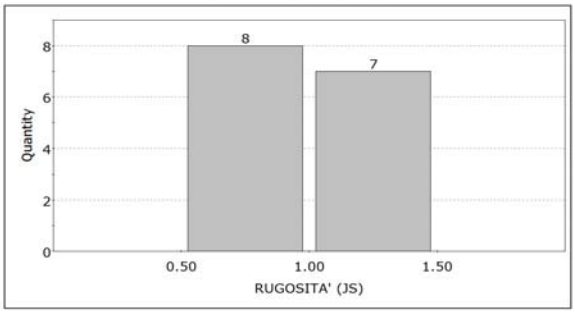


R SCHMIDT



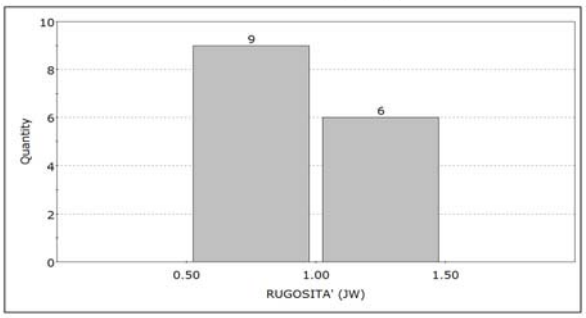
mean=13.875 s.d.=3.22656 min=11 max=21

RUGOSITA' (JS)



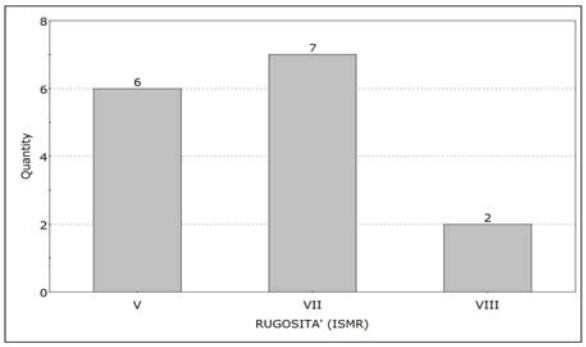
mean=1.23333 s.d.=0.258199 min=1 max=1.5

RUGOSITA' (JW)

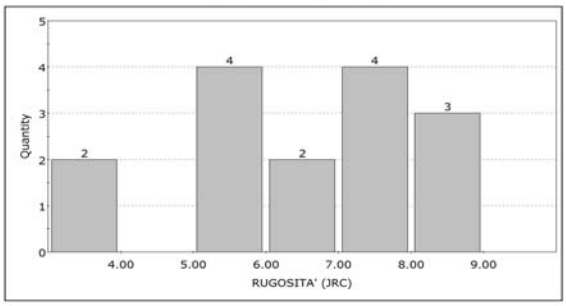


mean=1.2 s.d.=0.253546 min=1 max=1.5

RUGOSITA' (ISMR)



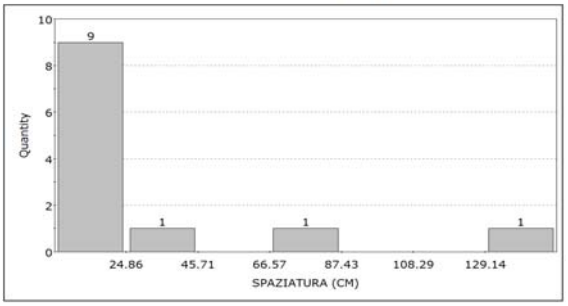
RUGOSITA' (JRC)



mean=7 s.d.=1.64751 min=4 max=9

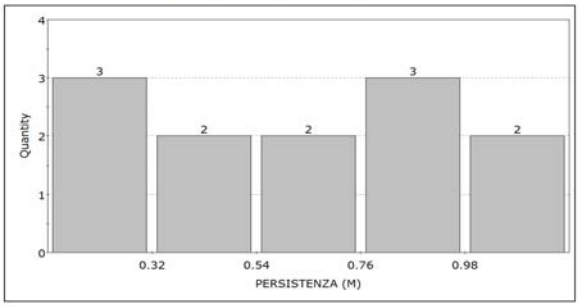
SET K1

SPAZIATURA (CM)



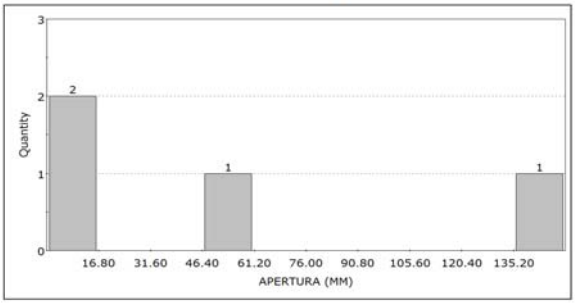
mean=29.0833 s.d.=43.5795 min=4 max=150

PERSISTENZA (M)



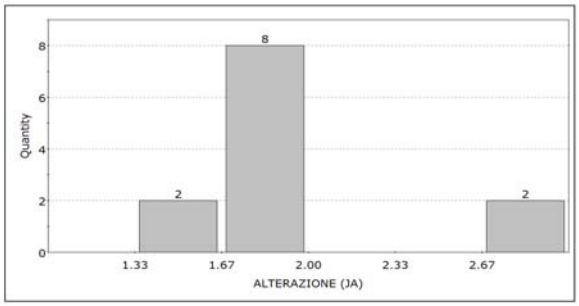
mean=0.620833 s.d.=0.342091 min=0.1 max=1.2

APERTURA (MM)



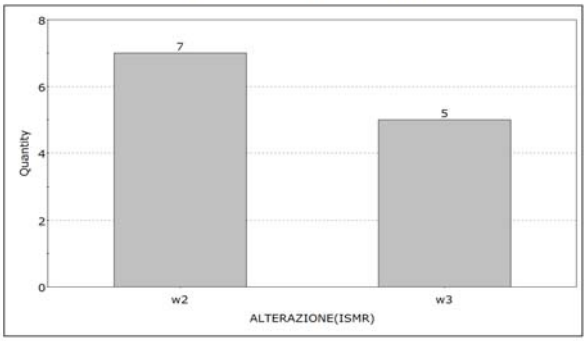
mean=54.25 s.d.=66.9745 min=2 max=150

ALTERAZIONE (JA)

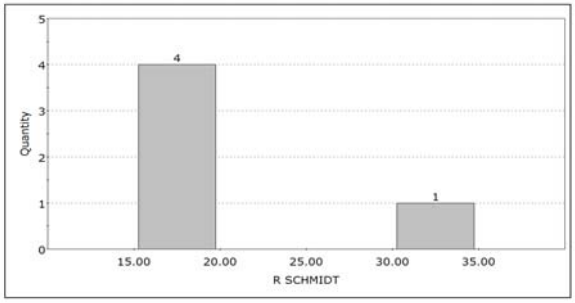


mean=2.08333 s.d.=0.468718 min=1.5 max=3

ALTERAZIONE(ISMR)

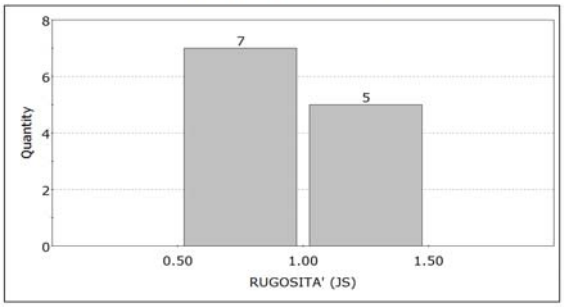


R SCHMIDT



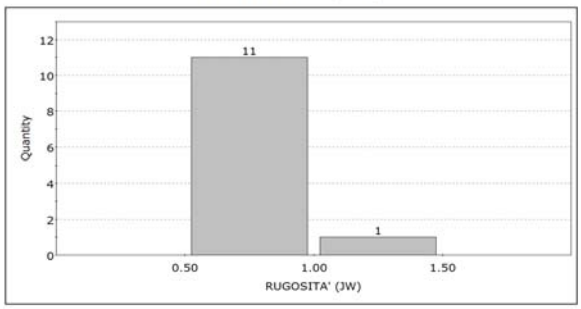
mean=20.2 s.d.=7.22496 min=16 max=33

RUGOSITA' (JS)



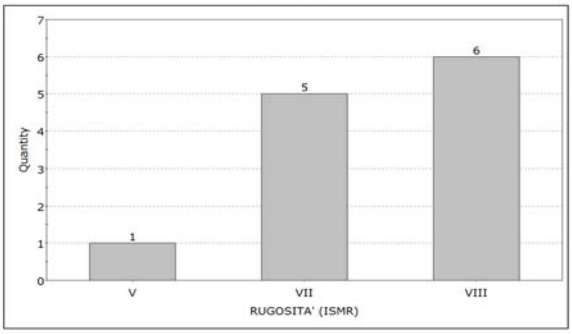
mean=1.20833 s.d.=0.257464 min=1 max=1.5

RUGOSITA' (JW)

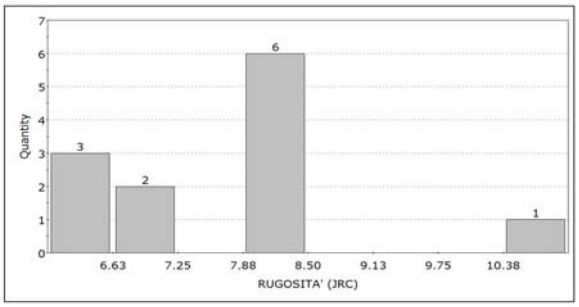


mean=1.04167 s.d.=0.144338 min=1 max=1.5

RUGOSITA' (ISMR)



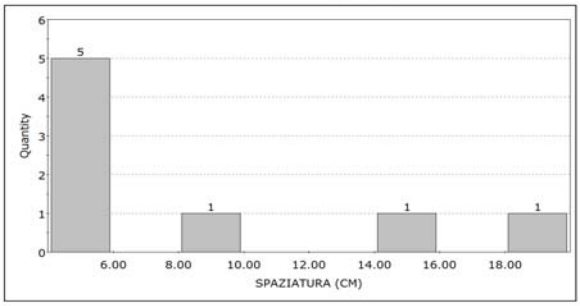
RUGOSITA' (JRC)



mean=7.58333 s.d.=1.37895 min=6 max=11

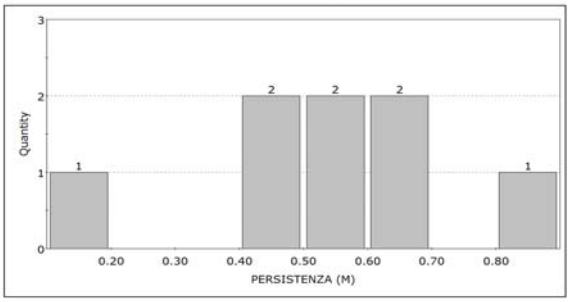
SET K2

SPAZIATURA (CM)



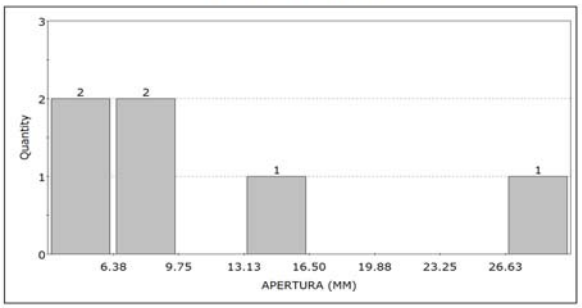
mean=8.75 s.d.=5.8493 min=4 max=20

PERSISTENZA (M)



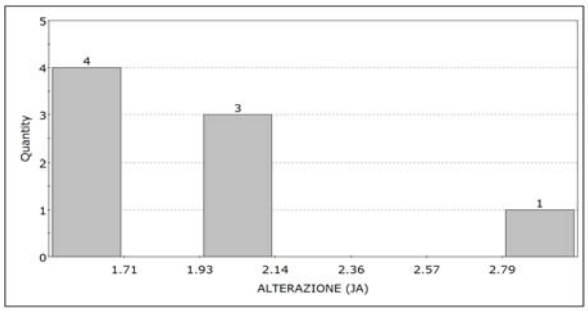
mean=0.575 s.d.=0.231455 min=0.1 max=0.9

APERTURA (MM)



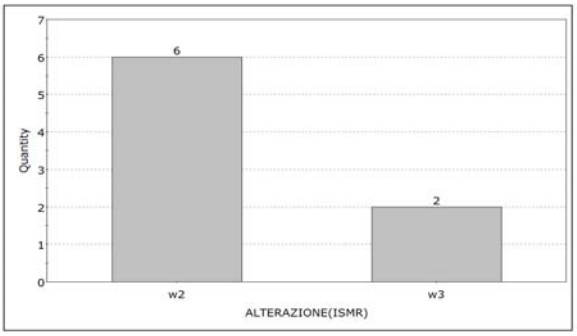
mean=11.3333 s.d.=10.0731 min=3 max=30

ALTERAZIONE (JA)

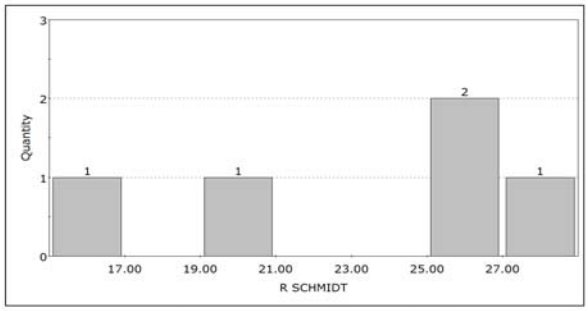


mean=1.875 s.d.=0.517549 min=1.5 max=3

ALTERAZIONE(ISMR)

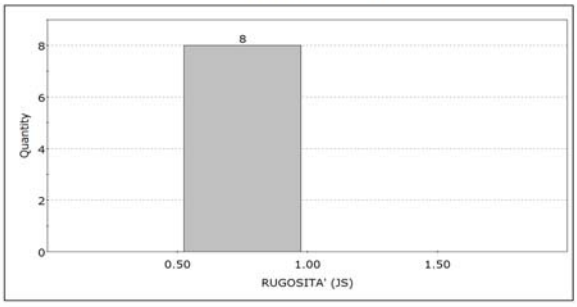


R SCHMIDT



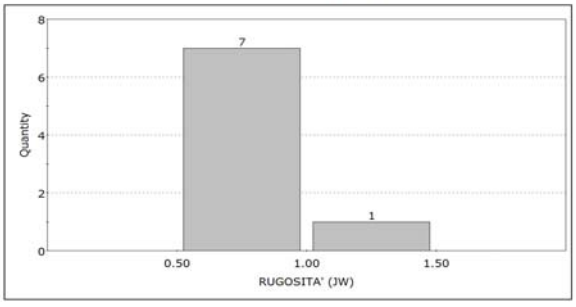
mean=23.8 s.d.=5.76194 min=15 max=29

RUGOSITA' (JS)



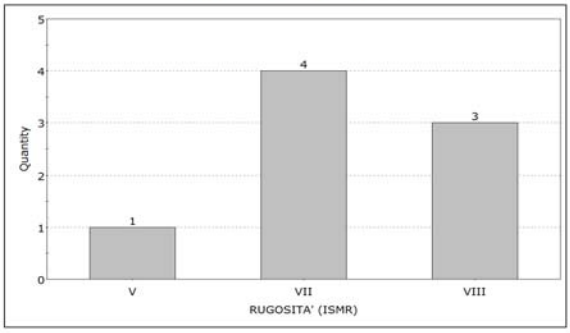
mean=1 s.d.=0 min=1 max=1

RUGOSITA' (JW)

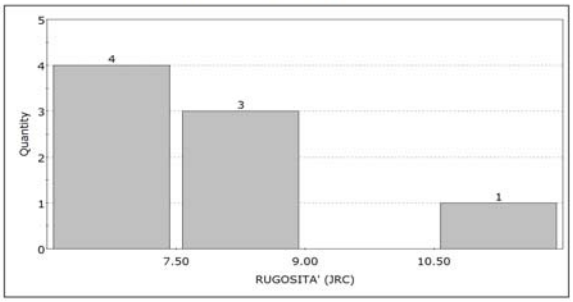


mean=1.0625 s.d.=0.176777 min=1 max=1.5

RUGOSITA' (ISMR)



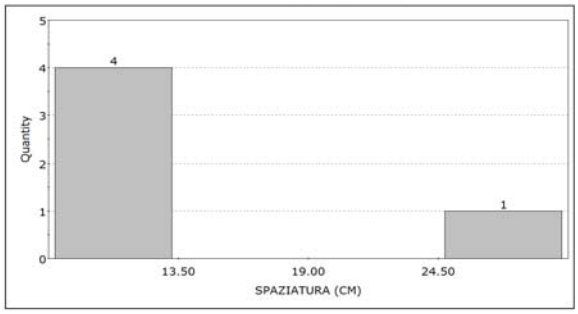
RUGOSITA' (JRC)



mean=7.875 s.d.=1.80772 min=6 max=12

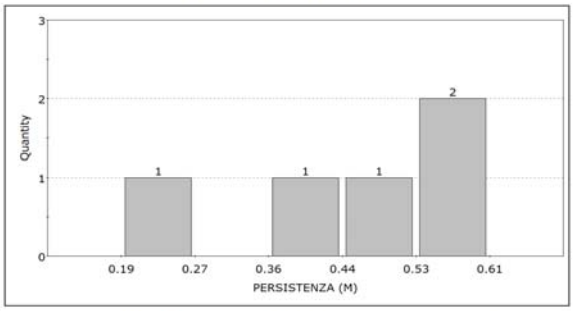
SET K3

SPAZIATURA (CM)



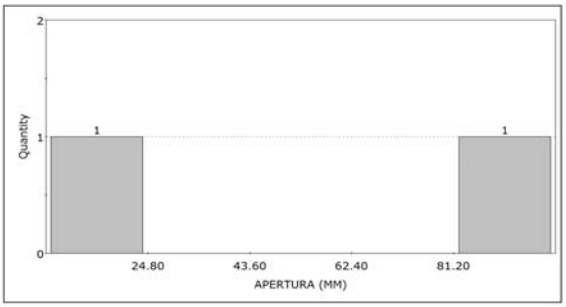
mean=13.6 s.d.=9.20869 min=8 max=30

PERSISTENZA (M)



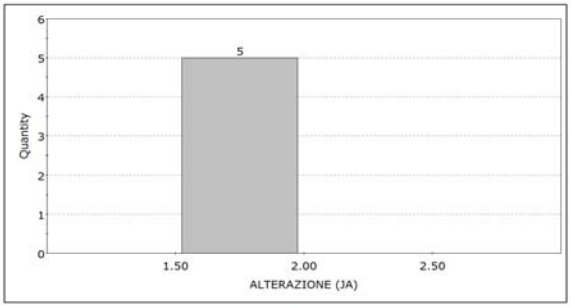
mean=0.46 s.d.=0.167332 min=0.2 max=0.6

APERTURA (MM)



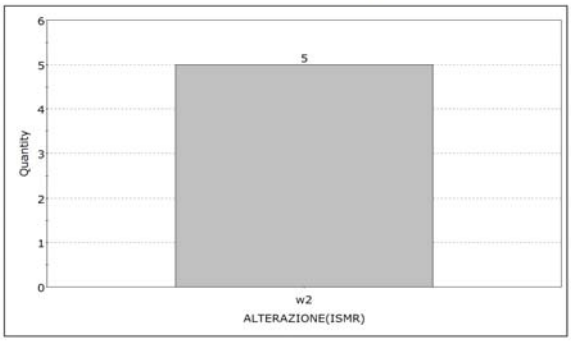
mean=53 s.d.=66.468 min=6 max=100

ALTERAZIONE (JA)

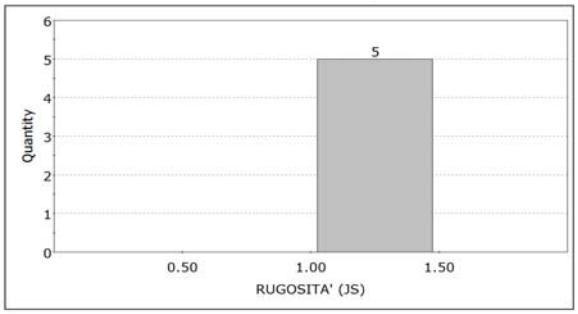


mean=2 s.d.=0 min=2 max=2

ALTERAZIONE(ISMR)

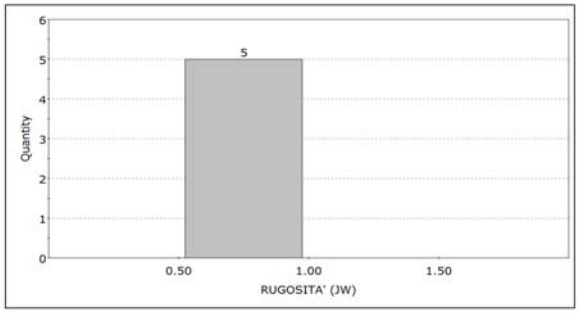


RUGOSITA' (JS)



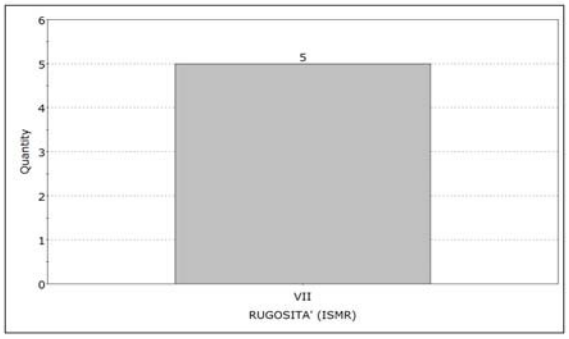
mean=1.5 s.d.=0 min=1.5 max=1.5

RUGOSITA' (JW)

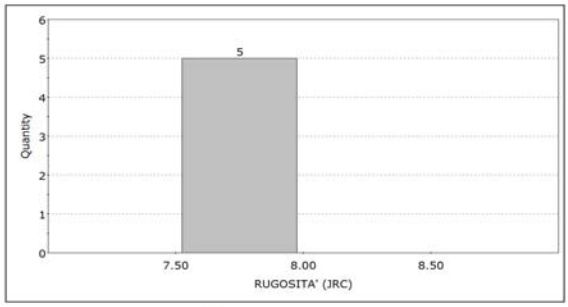


mean=1 s.d.=0 min=1 max=1

RUGOSITA' (ISMR)



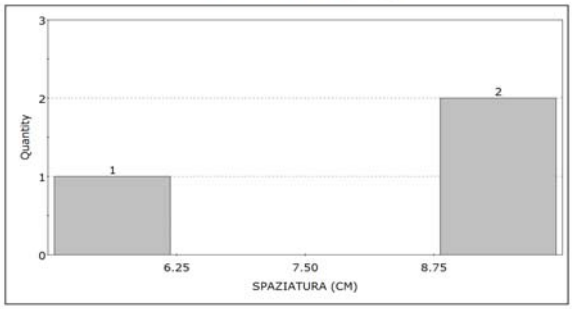
RUGOSITA' (JRC)



mean=8 s.d.=0 min=8 max=8

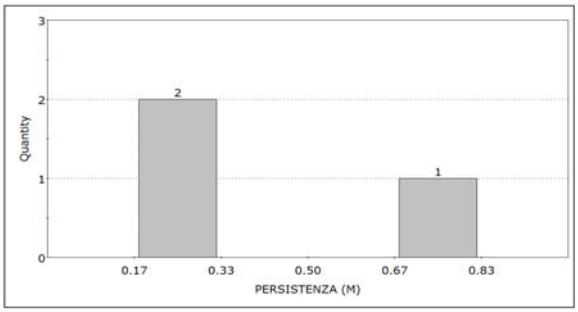
SET K4

SPAZIATURA (CM)



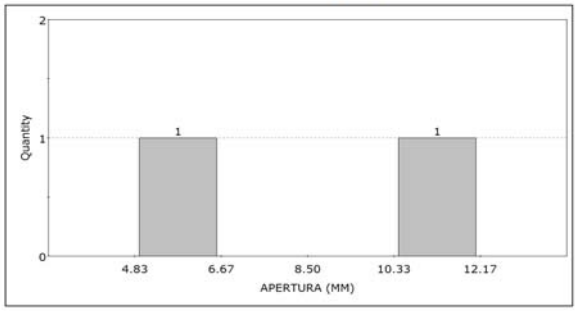
mean=8.33333 s.d.=2.88675 min=5 max=10

PERSISTENZA (M)



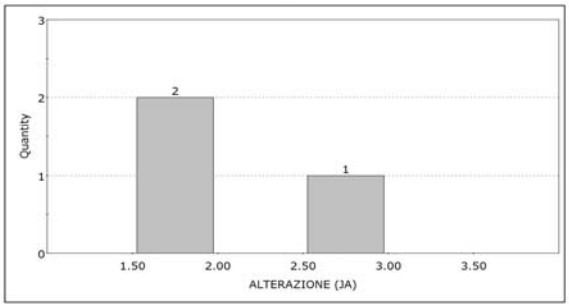
mean=0.433333 s.d.=0.321455 min=0.2 max=0.8

APERTURA (MM)



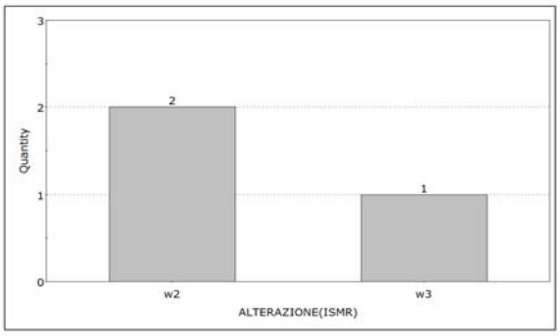
mean=8.5 s.d.=4.94975 min=5 max=12

ALTERAZIONE (JA)

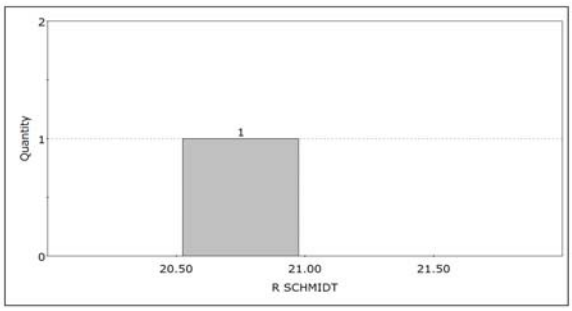


mean=2.33333 s.d.=0.57735 min=2 max=3

ALTERAZIONE(ISMR)

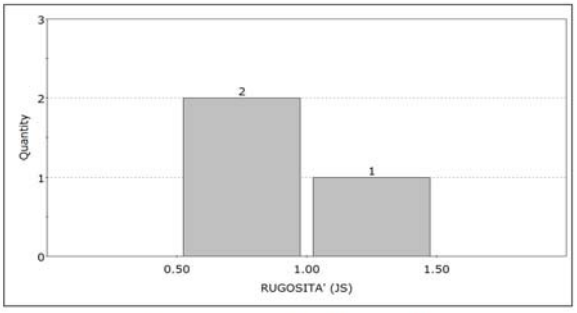


R SCHMIDT



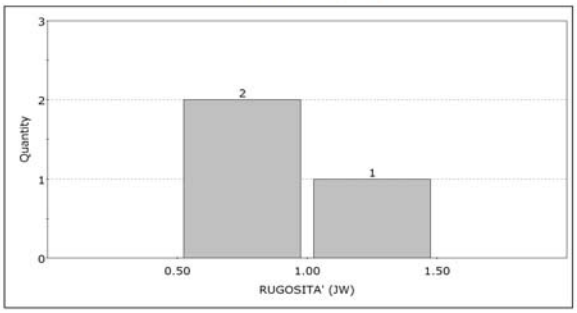
mean=21 s.d.=0 min=21 max=21

RUGOSITA' (JS)



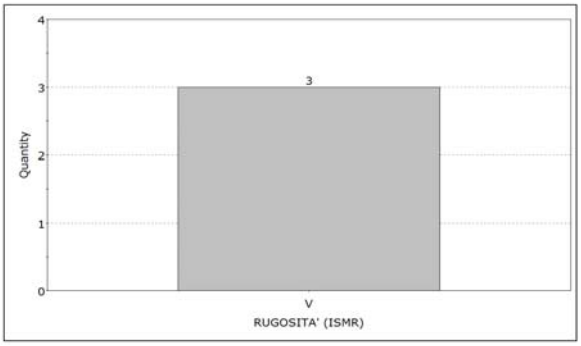
mean=1.16667 s.d.=0.288675 min=1 max=1.5

RUGOSITA' (JW)

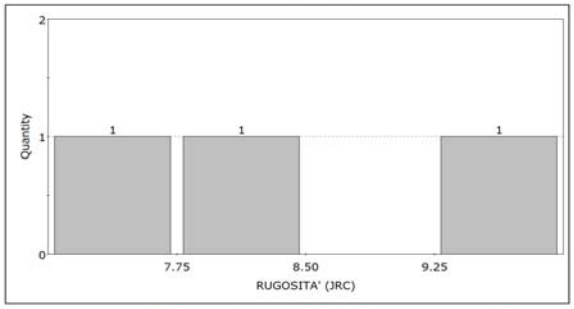


mean=1.16667 s.d.=0.288675 min=1 max=1.5

RUGOSITA' (ISMR)



RUGOSITA' (JRC)



mean=8.33333 s.d.=1.52753 min=7 max=10