

TEST REPORT No. 53

MATERIAL NAME: Moca Beige (Grey)

CLIENT : A&G 23 S.r.l.

STONELAB BY IMM **TECHNOLOGICAL LABORATORY FOR TESTING ON STONES**



PERFORMED TESTS:

- 1. Frost Resistance (Flex. & Compr. Strength EN 12371:2010)** **Tables 1-2**
- 2. Thermal Shock Resistance (EN 14066-2013)** **Tables 3-4**

Attachments: Load curves for EN 12371 (Flex. Strength & Compr. Strength) and EN 14066.

The Test Report No. 53 consists of 11 pages including this one.

Technological Laboratory Dr. Geol. Marco Mazzoni		DATE: July 21 st , 2015
--	---	---

<p style="text-align: center;">STONELAB by IMM Technological Laboratory Viale G.Galilei, 133 - 54033 M. di Carrara - Italy Tel. +39 0585 787963 - Fax. +39 0585 787602 E-mail: m.mazzoni@immcarrara.it A.S.T.M. MEMBER No. 1741518</p>	<p>TEST REPORT No. 53 RESULTS SUMMARY TABLES</p>
---	--

By request of **A&G 23 S.R.L.**, the under listed Tests have been performed on specimens of the material named by **A&G 23 S.R.L.**, “**Moca Beige (Grey)**”, quarried in Turkey.
 The relevant results have been reported in the tables enclosed to this document. The specimens under testing have been consigned to this laboratory by **A&G 23 S.R.L.** in date May 14th, 2015.
 No further information about the geological setting of this rock was given.

NOTE: the standard deviation and the coefficient of variation of mechanical tests have been indicated inside the tables enclosed to this test report.

Type of Test	Ref. Std.	Units	Conditioning	Average values		Std. Dev.
Frost Resistance (Ref.Specim – TR49) (Table 1)	EN 12371-2010; EN 12372-2007	MPa	Dry (ref.specim.)	14.21	Variation -8.30 %	0.90
			Dry (aft. No.56 EN 12371 cycles)	13.03		0.58
Frost Resistance (Ref.Specim – TR49) (Table 2)	EN 12371-2010; EN 1926-2007	MPa	Dry (ref.specim.)	104.22	Variation -10.19 %	11.74
			Dry (aft. No.56 EN 12371 cycles)	93.60		4.31
Resistance to Thermal Shock (Ref.Specim – TR49) (Table 3)	EN 14066-2013; EN 12372-2007	MPa	Dry (ref.specim.)	14.21	Variation 0.35 %	0.90
			Dry (aft. EN 14066 cycles)	14.26		0.76
Dynamic Elastic Modulus Variation (Table 4)	EN 14066-2013; EN 14146-2004	MPa	Dry Transv. before	47190	Variation -0,25 %	-
			Dry Transv. after	47070		-
			Dry Longit. before	45810	Variation 1.06 %	-
			Dry Longit. after	46290		-
			Dry Tors. before	1400	Variation 0.00 %	-
			Dry Tors. after	1400		-

Technological Laboratory Dr. Geol. Marco Mazzoni		DATE: July 21 st , 2015
--	--	---

Table 1

Natural Stone Test  BY IMM CARRARA ASTM MEMBER No. 1741518	Frost Resistance (UNI EN 12371:2010; UNI EN 12372:2007) - σ -	Client: A&G 23 S.r.l.
--	--	---------------------------------

Material: Moca Beige (Grey) Test Report No.: 53 Surface finish: Honed Specimens' delivery date: 14/05/2015 Test Batch: specimens subjected to No.56 EN 12371 cycles	Block No.: unknown Quarry location: Turkey Specimens' thickness: 30 mm Span: 150 mm
--	--

Specimen No.	Dimensions [mm] a x b x h	Conditioning Dry >48hrs/70°C after No.56 EN 12371 cycles	Actual Values				Notes
			Fmax [kN]	σ [MPa]	σ _{avdf} [MPa]	Strain F _{max} [mm]	
01DF	180x89.9x30.8	Dry	4.89	12.90	13.03	0.13	
02DF	180x90.0x30.5	Dry	4.86	13.06		0.13	
03DF	180x89.8x32.0	Dry	5.51	13.49		0.14	
04DF	180x89.9x30.7	Dry	4.88	12.97		0.14	
05DF	180x89.8x30.5	Dry	4.55	12.26		0.13	
06DF	180x89.9x31.4	Dry	5.57	14.13		0.13	
07DF	180x89.8x30.4	Dry	4.88	13.24		0.13	
08DF	180x90.0x30.8	Dry	4.99	13.15		0.14	
09DF	180x89.8x30.8	Dry	4.95	13.08		0.12	
10DF	180x89.6x30.3	Dry	4.40	12.04		0.12	

NOTES: Load applied perpendicular to rift edges

Average Flexural Strength after EN 12371 cycles (Dry), σ_{avdf} = 13.03 MPa

Standard deviation (Dry), S_{df} = 0.58 MPa

Coefficient of Variation (Dry) = 0.05

Lower Expected Value – Flexural Strength (Dry), σ_{df} = 11.85 MPa

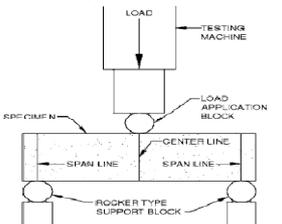
Load system schematic 	Technological Laboratory Dr.Geol. Marco Mazzoni 	DATE: July 21 st , 2015
---	---	---

Table 2

 ASTM MEMBER No. 1741518		Frost Resistance (UNI EN 12371:2010; UNI EN 1926:2007)		Client: A&G 23 S.r.l.			
Test Report No.: 53 Rock's Petrographic nature : Limestone Block No.: unknown Quarry location: Turkey			Material's commercial Name: Moca Beige (Grey) Specimens' delivery date: 14/05/2015 Test Batch: specimens subjected to No.56 EN 12371 cycles				
Specimen No.	Dimension [mm] a x b x h	Conditioning	Actual Values				Note
		Dry >48hrs/70°C after No.56 EN 12371 cycles	Fmax [kN]	C [MPa]	Average C _{mdf} [MPa]	S _{max} [µm]	
01 DF	50.8x50.0x50.1	Dry	231.01	90.95	93.60	408	
02 DF	51.2x50.0x49.8	Dry	244.79	95.62		340	
03 DF	50.9x50.1x50.7	Dry	221.65	86.92		385	
04 DF	50.7x50.0x50.0	Dry	241.59	95.30		370	
05 DF	51.5x50.0x49.8	Dry	255.41	99.19		381	
06 DF	51.0x50.0x50.0	Dry	236.77	92.85		340	
07 DF	51.1x50.2x49.8	Dry	225.64	87.96		448	
08 DF	50.8x50.0x50.0	Dry	232.00	91.34		388	
09 DF	51.0x50.1x50.1	Dry	247.56	96.89		397	
10 DF	51.0x50.1x49.9	Dry	252.90	98.98		361	
NOTE: Load applied perpendicular to rift <p style="text-align: center;"> Avg. Compressive Strength after EN 12371 cycles (Dry) C_{mdf} = 93.60 MPa Standard Deviation after EN 12371 cycles (Dry), s_{df} = 4.31 MPa Coefficient of variation after EN 12371 cycles (Dry), v_{df} = 0.05 Lower expected Value after EN 12371 cycles C_{df} = 84.85 MPa </p>							
Technological Laboratory Dr.Geol. Marco Mazzoni						Date: July 21 st , 2015	

Table 3

Natural Stone Test  BY IMM CARRARA ASTM MEMBER No. 1741518	Resistance to Thermal Shock (UNI EN 14066:2013; UNI EN 12372:2007) - σ -	Client: A&G 23 S.r.l.
--	---	---------------------------------

Material: Moca Beige (Grey) Test Report No.: 53 Surface finish: Honed Specimens' delivery date: 14/05/2015 Test Batch: specimens subjected to EN 14066 cycles	Block No.: unknown Quarry location: Turkey Specimens' thickness: 30 mm Span: 150 mm
--	--

Specimen No.	Dimensions [mm] a x b x h	Conditioning	Actual Values				Notes
			Dry >48hrs/70°C Aft. EN14066 cycles	Fmax [kN]	σ [MPa]	σ _{avds} [MPa]	
01DS	180x89.9x30.9	Dry	5.28	13.83	14.26	0.13	
02DS	180x90.0x30.3	Dry	5.49	14.95		0.14	
03DS	180x89.9x30.8	Dry	5.64	14.89		0.13	
04DS	180x90.5x31.0	Dry	5.52	14.28		0.15	
05DS	180x89.9x30.4	Dry	5.59	15.13		0.15	
06DS	180x89.8x30.6	Dry	5.45	14.57		0.15	
07DS	180x90.1x30.4	Dry	5.41	14.63		0.15	
08DS	180x89.7x30.5	Dry	4.95	13.34		0.15	
09DS	180x90.3x30.7	Dry	5.29	13.99		0.14	
10DS	180x90.0x31.6	Dry	5.19	12.98		0.14	

NOTES: Load applied perpendicular to rift edges

Average Flexural Strength after EN 14066 cycles (Dry), σ_{avds} = 14.26 MPa

Standard deviation (Dry), S_{ds} = 0.72 MPa

Coefficient of Variation (Dry) = 0.05

Lower Expected Value – Flexural Strength (Dry), σ_{ds} = 12.80 MPa

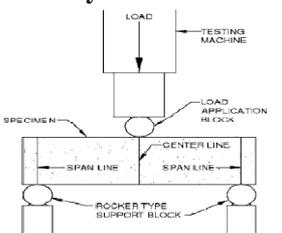
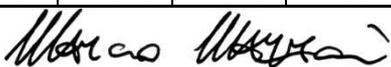
Load system schematic 	Technological Laboratory Dr.Geol. Marco Mazzoni 	DATE: July 21 st , 2015
---	---	---

Table 4

Natural Stone Test STONE LAB BY IMM CARRARA ASTM MEMBER No. 1741518					Dynamic Elastic Modulus of Elasticity (UNI EN 14146:2004; UNI EN 14066:2013)				Client: A&G 23 S.r.l.			
Material: Moca Beige (Grey) Test Report No.: 53 Surface finish: Honed							Block No.: unknown Test Standard: UNI EN 14146 Specimens' thickness: 30 mm					
Transverse dynamic young modulus												
Specim No.	Mass (kg)	Dimension			Actual Values							
		Length (mm)	Width (mm)	Thk. (mm)	Resonance freq. (Hz)		Transv. El. Mod.(MPa)		Avg. Transv. El. Mod.(MPa)		Avg. variation %	
					Before	After	Before	After	Before	After		
01DS	1.23	181	89.9	30.9	3900	3912	47800	48100				
02DS	1.20	181	90.0	30.3	3784	3772	46300	46000				
03DS	1.22	181	89.9	30.8	3870	3876	47100	47300				
04DS	1.22	181	90.5	31.0	3833	3864	45100	45900				
05DS	1.20	181	89.9	30.4	3802	3802	46300	46300	47190	47070	-0,25 %	
06DS	1.22	181	89.8	30.6	3888	3876	48500	48200				
07DS	1.21	181	90.1	30.4	3870	3851	48300	47800				
08DS	1.21	181	89.7	30.5	3882	3864	48400	47900				
09DS	1.23	181	90.3	30.7	3900	3894	48500	48300				
10DS	1.23	181	90.0	31.6	3925	3894	45600	44900				
Longitudinal dynamic young modulus												
Specim No.	Mass (kg)	Dimension			Actual Values							
		Length (mm)	Width (mm)	Thk. (mm)	Resonance freq. (Hz)		Long. Elastic Mod(MPa)		Avg. Long. El. Mod.(MPa)		Avg. variation %	
					Before	After	Before	After	Before	After		
01DS	1.23	181	89.9	30.9	12030	12091	46400	46900				
02DS	1.20	181	90.0	30.3	11859	11920	44800	45300				
03DS	1.22	181	89.9	30.8	11896	12030	45200	46200				
04DS	1.22	181	90.5	31.0	11877	12024	44400	45600				
05DS	1.20	181	89.9	30.4	11926	12006	45200	45900	45810	46290	1.06 %	
06DS	1.22	181	89.8	30.6	12048	12097	46700	47100				
07DS	1.21	181	90.1	30.4	12048	12036	46500	46400				
08DS	1.21	181	89.7	30.5	12079	12128	46800	47100				
09DS	1.23	181	90.3	30.7	12067	12109	46800	47100				
10DS	1.23	181	90.0	31.6	12030	12018	45300	45300				
Torsional dynamic young modulus												
Specim No.	Mass (kg)	Dimension			Actual Values							
		Length (mm)	Width (mm)	Thk. (mm)	Resonance freq. (Hz)		Tors. El. Mod. (MPa)		Avg. Tors.El. Mod.(MPa)		Avg. variation %	
					Before	After	Before	After	Before	After		
01DS	1.23	181	89.9	30.9	12823	12836	1500	1500				
02DS	1.20	181	90.0	30.3	12683	12378	1300	1300				
03DS	1.22	181	89.9	30.8	12677	12738	1400	1400				
04DS	1.22	181	90.5	31.0	12744	12756	1400	1400				
05DS	1.20	181	89.9	30.4	12720	12848	1300	1300	1400	1400	0.00 %	
06DS	1.22	181	89.8	30.6	12781	12701	1400	1400				
07DS	1.21	181	90.1	30.4	12805	12659	1300	1300				
08DS	1.21	181	89.7	30.5	12823	12750	1400	1400				
09DS	1.23	181	90.3	30.7	12842	12805	1400	1400				
10DS	1.23	181	90.0	31.6	12848	12726	1600	1600				
Technological Laboratory Dr.Geol. Marco Mazzoni									Date: July 21 st , 2015			

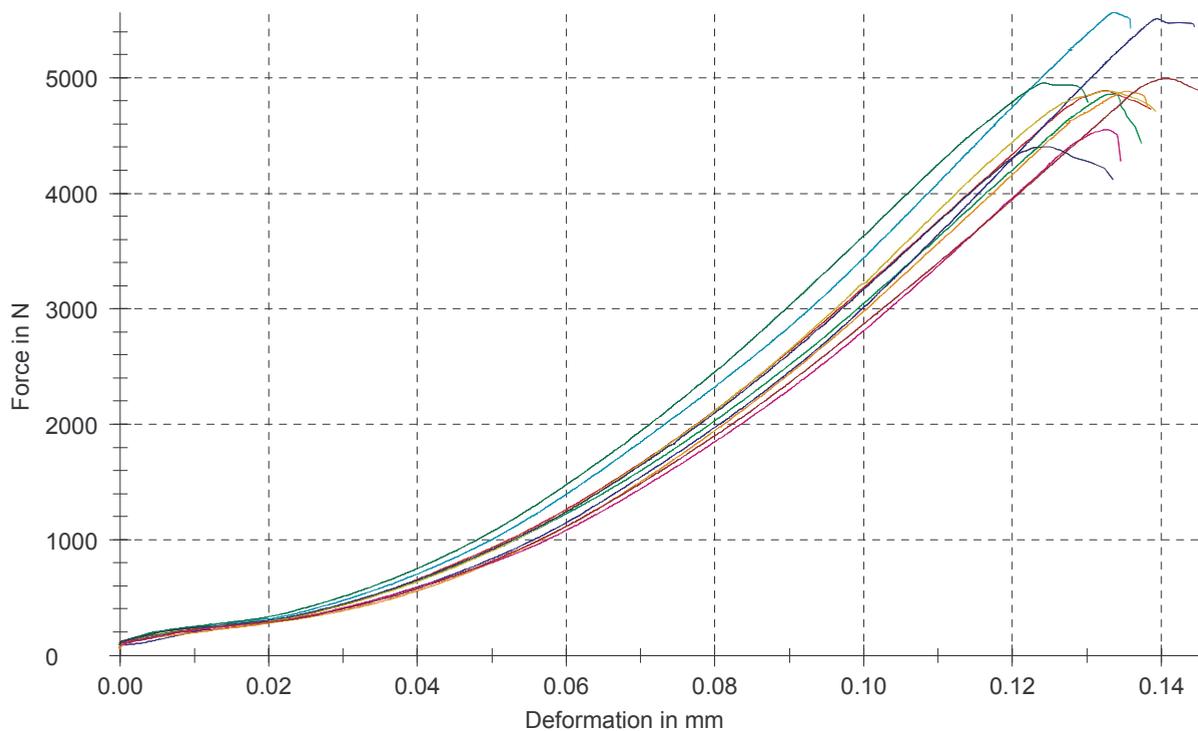
Test Report No.53

Client : A&G 23 S.r.l.
 Ref. Norm : EN 12371:2010; EN 12372 - 2007
 Material name : Moca Beige (Grey) - Dry after No.56 EN 12371 cycles - Perpendicular to rift edges - Honed finish
 Pre-load : 44 N
 Test speed : 0,25 MPa/s

Test results:

Legenda	No.	Specim.No.	Flex.Strength MPa	F.max N	Def. at Fmax mm	Span mm	Spec.Thk mm	Specim.Width mm
	1	01DF	12,90	4889,11	0,13	150	30,8	89,9
	2	02DF	13,06	4859,71	0,13	150	30,5	90,0
	3	03DF	13,49	5512,00	0,14	150	32,0	89,8
	4	04DF	12,97	4883,07	0,14	150	30,7	89,9
	5	05DF	12,26	4551,14	0,13	150	30,5	89,8
	6	06DF	14,13	5565,06	0,13	150	31,4	89,9
	7	07DF	13,24	4884,48	0,13	150	30,4	89,8
	8	08DF	13,15	4991,64	0,14	150	30,8	90,0
	9	09DF	13,08	4953,51	0,12	150	30,8	89,8
	10	10DF	12,04	4400,90	0,12	150	30,3	89,6

Load/Strain Graphs:



Statistics:

A&G 23 S.r.l. n = 10	Flex.Strength MPa	F.max N	Def. at Fmax mm	Span mm	Spec.Thk mm	Specim.Width mm
\bar{x}	13,03	4949,06	0,13	150	30,8	89,9
s	0,58	361,65	0,01	0,00	0,52	0,12
v	4,49	7,31	4,00	0,00	1,67	0,13

TEST REPORT NO.53

Date: 21/07/15

Ref. Norm.:

EN 1926:2005;EN 12371:2010

Client: A&G 23 S.r.l.

Material: Moca Beige (Grey)

Test Device: Controls Mod.C56Z00

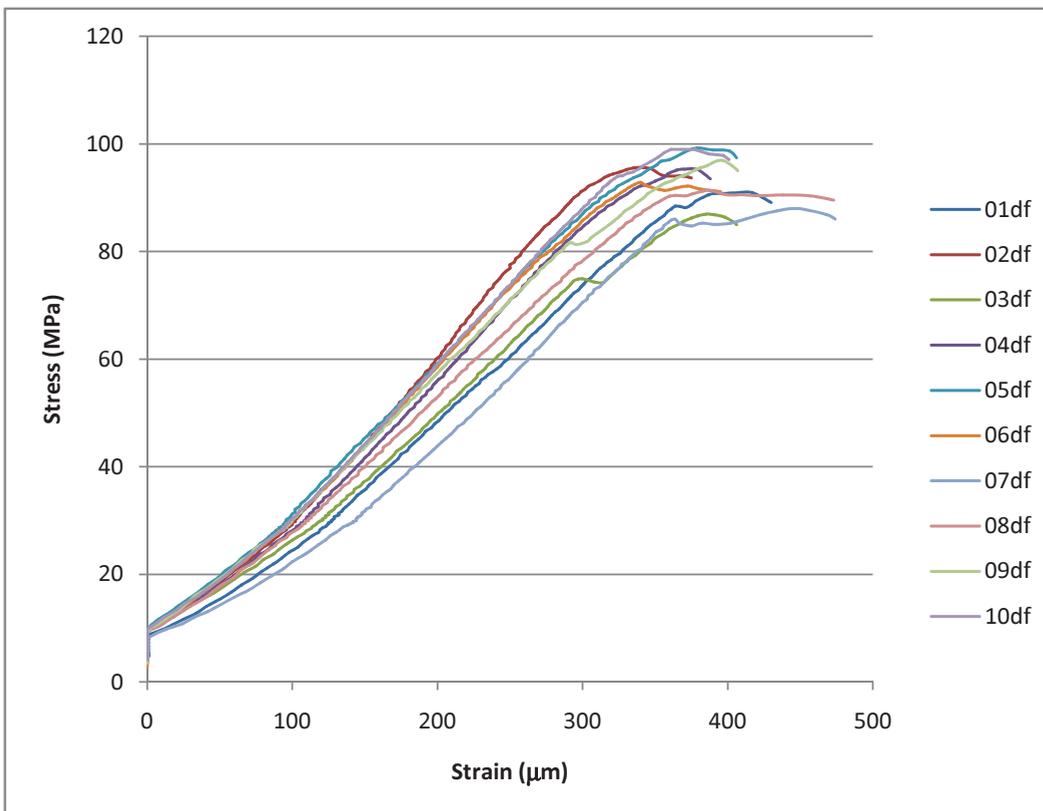
Test Speed: 0,5 MPa/sec

Load applying dir: perpendicular to rift direction

Condition: Dry aft EN12371 cycles

Specim.No	a (mm)	b (mm)	c (mm)	Area (mm ²)	Force (kN)	Compr. Strength (MPa)	Strain at Fmax (μm)
01	50,80	50,00	50,10	2540,00	231,01	90,95	408
02	51,20	50,00	49,80	2560,00	244,79	95,62	340
03	50,90	50,10	50,70	2550,09	221,65	86,92	385
04	50,70	50,00	50,00	2535,00	241,59	95,30	370
05	51,50	50,00	49,80	2575,00	255,41	99,19	381
06	51,00	50,00	50,00	2550,00	236,77	92,85	340
07	51,10	50,20	49,80	2565,22	225,64	87,96	448
08	50,80	50,00	50,00	2540,00	232,00	91,34	388
09	51,00	50,10	50,10	2555,10	247,56	96,89	397
10	51,00	50,10	49,90	2555,10	252,90	98,98	361

Average Compr. Strength : 93,60 MPa
 Standard deviation : 4,31 MPa



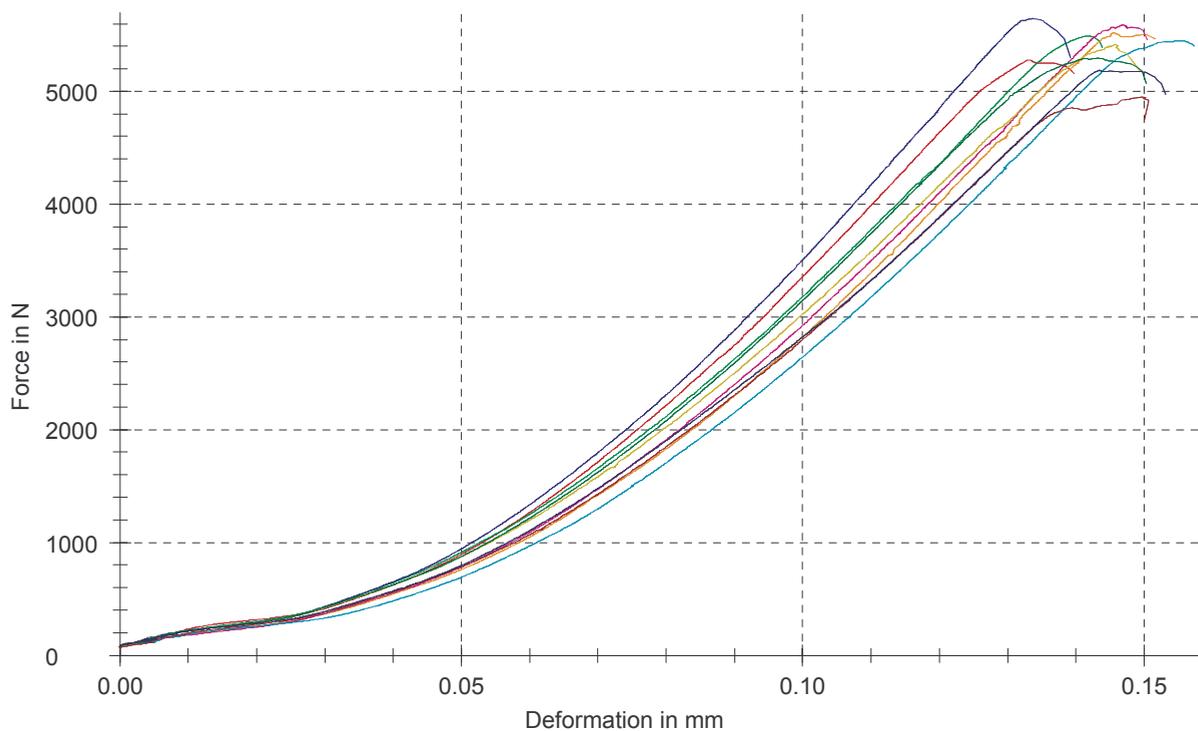
Test Report No.53

Client : A&G 23 S.r.l.
 Ref. Norm : EN 14066:2013; EN 12372 - 2007
 Material name : Moca Beige (Grey) - Dry after EN 14066 cycles - Perpendicular to rift edges - Honed finish
 Pre-load : 44 N
 Test speed : 0,25 MPa/s

Test results:

Legenda	No.	Specim.No.	Flex.Strength MPa	F.max N	Def. at Fmax mm	Span mm	Spec.Thk mm	Specim.Width mm
	1	01DS	13,83	5276,94	0,13	150	30,9	89,9
	2	02DS	14,95	5491,23	0,14	150	30,3	90,0
	3	03DS	14,89	5644,26	0,13	150	30,8	89,9
	4	04DS	14,28	5518,96	0,15	150	31,0	90,5
	5	05DS	15,13	5587,68	0,15	150	30,4	89,9
	6	06DS	14,57	5446,61	0,15	150	30,6	89,8
	7	07DS	14,63	5412,87	0,15	150	30,4	90,1
	8	08DS	13,34	4947,66	0,15	150	30,5	89,7
	9	09DS	13,99	5293,27	0,14	150	30,7	90,3
	10	10DS	12,98	5185,40	0,14	150	31,6	90,0

Load/Strain Graphs:



Statistics:

A&G 23 S.r.l. n = 10	Flex.Strength MPa	F.max N	Def. at Fmax mm	Span mm	Spec.Thk mm	Specim.Width mm
\bar{x}	14,26	5380,49	0,14	150	30,7	90,0
s	0,72	208,99	0,01	0,00	0,39	0,24
v	5,02	3,88	4,63	0,00	1,25	0,26