



POLITECNICO DI TORINO

LABORATORIO MARMO

Dipartimento di Ingegneria del Territorio, dell'Ambiente e delle Geotecnologie

TECHNICAL QUALIFICATION OF ORNAMENTAL ROCKS FOR THE REALIZATION OF A
TECHNICAL-COMMERCIAL CATALOGUE DEDICATED TO "LE PIETRE DI TOSCANA"

REPORT N. 16

TRAVERTINO DI MONTEMERANO BIANCO MAREMMA

April 6th, 2010

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The Responsible in charge
(Dr. Paola Marini)



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Specimens supplied

The specimens with shapes and dimensions suitable for tests have been delivered to Laboratorio Marmo of DITAG on January 25st, 2010.

Sampling report

Samplings have been made by the customer (report of march 12th, 2010).

Description of material (according to EN 12440:2008)

Traditional name: TRAVERTINO DI MONTEMERANO BIANCO MAREMMA



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Requested tests:

The following tests have been requested, according to EN 1341, EN 1342, EN 1343, EN 1469, EN 12057, EN 12058:

- water absorption at atmospheric pressure according to Standard EN 13755
- apparent density and open porosity according to Standard EN 1936
- flexural strength under concentrated load according to Standard EN 12372
- frost resistance according to Standards EN 12371 and EN 12372
- uniaxial compressive strength according to Standard EN 1926
- slip resistance according to Standard EN 14231

The following results refer only to tested specimens.



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TECHNICAL-COMMERCIAL CATALOGUE DEDICATED TO "LE PIETRE DI TOSCANA"**DETERMINATION OF WATER ABSORPTION AT ATMOSPHERIC PRESSURE****Operating test modes**

- The test has been performed according to Standard EN 13755 "Natural stone test methods – Determination of water absorption at atmospheric pressure" - 2008.

Date of testings: february 4th, 2010

Specimens: 6 with 50 x 50 x 50 mm edges.

Specimen identi- fication number	Mass of the dried specimen (g)	Mass of the saturated specimen in water (g)	Water absorption (% by mass)			
			Individual values	Mean value	Standard dev.	Maximum expected value
1	313,06	316,80	1,19			
2	303,80	307,47	1,21			
3	306,09	310,07	1,30			
4	316,52	319,78	1,03	1,30	0,46	2,57
5	313,07	319,92	2,19			
6	317,15	319,94	0,88			



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- The test has been performed in according to Standard EN 1936 "Natural stone test methods – Determination of real density and apparent density, and of total and open porosity" - 2006.

Date of testings: february 4th, 2010

Specimens: 6 with 50 x 50 x 50 mm edges.

Specimen identi- fication number	Mass of the dried specimen (g)	Apparent volume (mm ³)	Apparent density (kg/m ³)			Open porosity (%)		
			Individual values	Mean value	Standard dev.	Individual values	Mean value	Standard dev.
1	313,07	128,48	2430			7,7		
2	317,07	128,20	2470			7,0		
3	318,13	127,72	2490			6,4		
4	306,66	127,16	2410	2460	36,7	8,8	7,3	1,1
5	311,24	127,74	2430			8,0		
6	321,10	128,20	2500			5,8		

N.B. the apparent volume was determined by measuring the dimensions of each specimen, due to the visible cavities of the stone (EN 1936:2006, § 8.1).

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DETERMINATION OF FLEXURAL STRENGTH UNDER CONCENTRATED LOAD ON A SAMPLE IN NATURAL CONDITIONS AND A SAMPLE EXPOSED TO FROST CYCLES

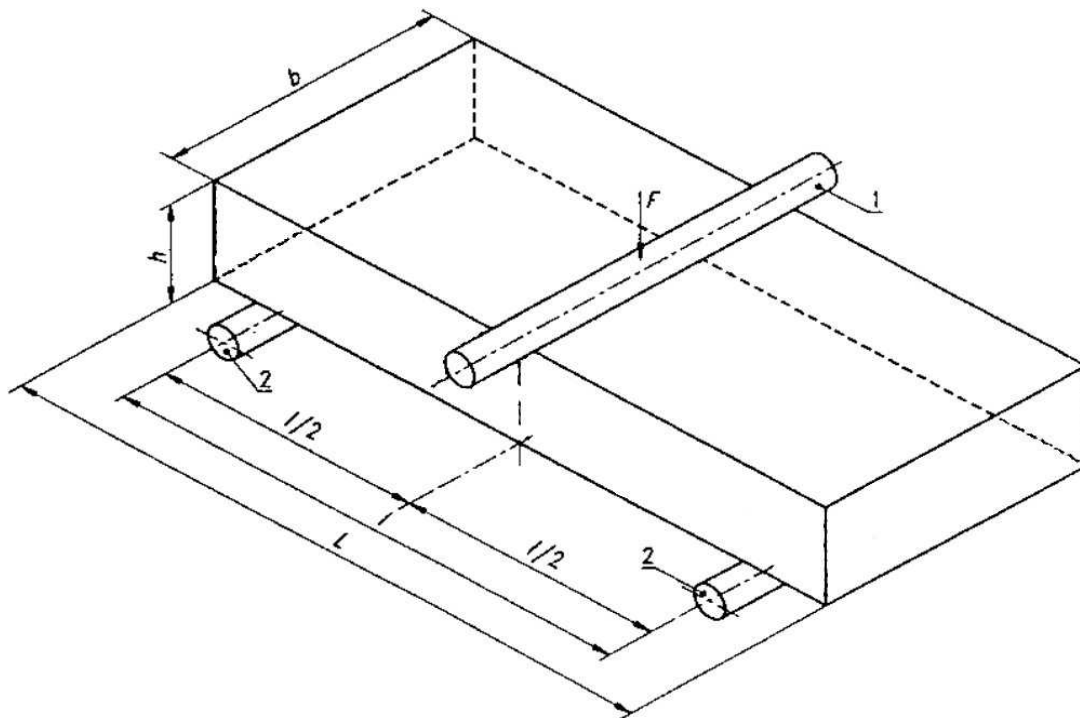
Operating test modes

- The test for the flexural strength under concentrated load has been performed in according to EN 12372 "Natural stone test methods - Determination of flexural strength under concentrated load" - 2006.

- The frost resistance test has been performed in according to EN 12371 "Natural stone test methods – Determination of frost resistance" - 2001.

48 frost cycles have been performed.

Date of testings: march 1st, 2010



Distance between the supporting rollers = 125 mm

1) Specimens: 10 with 150 x 50 x 25 mm edges in natural conditions.

Specimen identi- fication number	Thickness h (mm)	Width b (mm)	Breaking load F (N)	Flexural strength σ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
1	25,1	50,2	2278	13,5			
2	25,0	50,0	2104	12,6			
3	25,0	50,0	1894	11,4			
4	25,1	50,0	852	5,1			
5	25,2	50,3	2707	15,9	10,6	3,4	4,5
6	25,0	49,9	1756	10,6			
7	25,2	50,2	1639	9,6			
8	25,0	50,2	1955	11,7			
9	24,7	49,9	823	5,1			
10	25,0	49,9	1775	10,7			

Distance between the supporting rollers = 125 mm

2) Specimens: 10 with 150 x 50 x 25 mm edges exposed to 48 frost cycles.

Specimen identi- fication number	Thickness h (mm)	Width b (mm)	Breaking load F (N)	Flexural strength σ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
1	24,7	50,0	1746	10,7			
2	25,2	50,3	1633	9,6			
3	25,1	50,3	1694	10,0			
4	24,9	49,8	2543	15,4			
5	25,1	50,2	849	5,0	9,6	2,9	4,7
6	25,0	50,0	1959	11,8			
7	25,2	49,9	1775	10,5			
8	24,9	50,0	1036	6,3			
9	25,0	50,3	1432	8,5			
10	25,0	50,2	1313	7,8			

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TECHNICAL-COMMERCIAL CATALOGUE DEDICATED TO "LE PIETRE DI TOSCANA"**DETERMINATION OF UNIAXIAL COMPRESSIVE STRENGTH ON A SAMPLE IN
NATURAL CONDITIONS****Operating test modes**

- The test has been performed in according to Standard EN 1926: "Natural stone test methods – determination of uniaxial compressive strength" 2006.

Date of testings: february 11th, 2010

Load is applied in perpendicular direction to the planes of anisotropy.

- Specimens: 6 cubes with 70 mm edge in natural conditions.

Specimen identi- fication number	Side a (mm)	Side b (mm)	Breaking load (N)	Compressive strength σ (MPa)				
				Individual values	Mean value	Standard Dev.	Variation Coeff.	Minimum expected value
1	70	70	420	85,32				
2	70	70	403	82,40				
3	70	70	437	89,09				
4	70	70	334	68,07	78	10	0,12	58
5	70	70	393	80,51				
6	70	70	322	65,48				



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TESTER****Operating test modes**

- The test has been performed in accordance to Standard EN 14231: "Natural stone test methods - Determination of the slip resistance by means of the pendulum tester" - 2003.

Date of testings: february 22nd, 2010

Specimen with honed surface

- Specimens: 6 slabs with 200 x 200 x 10 mm edges.

Specimen identif. number	Slip resistance value (SRV dry)	Mean slip resistance value (SRV dry)	Standard Dev.	Minimum expected value	Slip resistance value (SRV wet)	Mean slip resistance value (SRV wet)	Standard Dev.	Minimum expected value
1	55				30			
2	55				36			
3	54				31			
4	54	54	1,4	51	37	33	3,1	26
5	52				30			
6	56				32			

Note: The average value of slip resistance is less than 35



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TABLE OF RESULTS

		U.M.	av. value	st. dev.
water absorption at atmospheric pressure		%	1,30	0,46
apparent density		kg/m ³	2480	32,1
open porosity		%	7,4	1,14
flexural strength under concentrated load	(in natural conditions)	MPa	10,6	3,4
	(exposed to 48 frost cycles)	MPa	9,6	2,9
uniaxial compressive strength		MPa	78,5	9,6
slip resistance	honed surface (dry)	USRV	54	1
	honed surface (wet)	USRV	33	3