



**Politecnico  
di Torino**

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

MARBLE AND NATURAL STONES LABORATORY

**Rec. n. 0046411 del 18/11/21**

2021/11/24

REPORT 10/58/2021

DETERMINATION OF PHYSICAL AND MECHANICAL PROPERTIES  
ON A SAMPLE OF NATURAL STONE NAMED CREMO DELICATO  
COMING FROM CAVA CREMOMARMI SRL N.113  
PONTI DI VARA (MS)  
REQUIRED BY MARMIDI VARA SRL

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Testings coordinator  
(prof. Rossana Bellopede)

The department manager  
(prof. Francesco Laio)



DETERMINATION OF PHYSICAL AND MECHANICAL PROPERTIES ON A SAMPLE OF NATURAL STONE  
NAMED CREMO DELICATO COMING FROM CAVA CREMOMARMI SRL N.113  
REQUIRED BY MARMI DI VARA SRL

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**Rec. n. 0046411 del 18/11/21**  
**Report n. 10/58/2021**

**Customer**

MARMI DI VARA SRL via I.Cocchi, 1 - 54033 AVENZA CARRARA (MS)  
V.A.T. 01000100451

**Request data**

Request registered on 2021/09/16 with number 0034539.

**Specimens supplied**

The customer supplied (at the same time with request) the specimens with shapes and dimensions suitable for tests.

**Description of material (according to EN 12440:2017)**

traditional name: CREMO DELICATO  
petrographic name: marble  
region of extraction: CAVA CREMOMARMI SRL N.113  
PONTI DI VARA (MS)

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### Tests requested:

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

<input checked="" type="checkbox"/>	- petrographic examination according to Standard EN 12407
<input checked="" type="checkbox"/>	- water absorption at atmospheric pressure according to Standard EN 13755
<input checked="" type="checkbox"/>	- apparent density and open porosity according to Standard EN 1936
<input checked="" type="checkbox"/>	- flexural strenght under concentrated load according to Standard EN 12372
<input checked="" type="checkbox"/>	- frost resistance according to Standards EN 12371 and EN 12372
<input checked="" type="checkbox"/>	- uniaxial compressive strength according to Standard EN 1926
<input type="checkbox"/>	- frost resistance according to Standards EN 12371 and EN 1926
<input checked="" type="checkbox"/>	- abrasion resistance according to Standard EN 14157
<input checked="" type="checkbox"/>	- slip resistance by means of the pendulum tester according to Standard EN 14231
<input type="checkbox"/>	- water absorption coefficient by capillarity according to Standard EN 1925
<input checked="" type="checkbox"/>	- resistance to ageing by thermal shock according to Standard EN 14066
<input type="checkbox"/>	- breaking load at dowel hole according to Standard EN 13364
<input type="checkbox"/>	- Knoop hardness according to Standard EN 14205 on a polished section
<input type="checkbox"/>	- linear thermal expansion coefficient according to Standard EN 14581

**The sampling and the data relative to the trading name and the place of origin are supplied from customer and are not responsibility of the test laboratory.**

**The following results refer only to tested specimens.**

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## PETROGRAPHIC EXAMINATION

### Test method

- The test has been performed according to Standard EN 12407 "*Natural stone test methods – Petrographic examination*" - 2007.

Specimens: thin section 30  $\mu\text{m}$ .

### Description

The rock shows, in the hand sample, a white color with brown veins, with a fine grain and saccharoidal texture.

When tested with diluted hydrochloric acid, the effervescence is high: the content of calcium carbonate is probably higher than 90%.

### Composition:

- calcite (98 %), with crystals with dimensions 0.05 - 0,5 mm, sometimes geminated and polygonal grains;
- white mica (2 %), in sheets oriented along preferential planes ;
- accessory minerals (quartz, pyrite).

The rock is a marble.

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## DETERMINATION OF WATER ABSORPTION AT ATMOSPHERIC PRESSURE

### Test method

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

Date of testing: 2021/09/23

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	340,08	340,47	0,11			
2	340,80	341,15	0,10			
3	339,62	340,01	0,11			
4	342,55	342,90	0,10	0,11	0,01	0,12
5	339,50	339,87	0,11			
6	342,07	342,43	0,11			

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## DETERMINATION OF APPARENT DENSITY AND OPEN POROSITY

### Test method

- 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" - 2007.

Date of testing: 2021/09/21

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)	Mass of the saturated specimen in air (g)	Apparent density (kg/m <sup>3</sup> )			Open porosity (%)		
				Individual values	Mean value	Standard dev.	Individual values	Mean value	Standard dev.
1	341,00	216,02	341,54	2710			0,4		
2	342,21	216,79	342,75	2710			0,4		
3	342,93	217,20	343,46	2710	2710	0,0	0,4	0,4	0,0
4	337,19	213,56	337,69	2710			0,4		
5	341,16	216,09	341,75	2710			0,5		
6	340,27	215,54	340,79	2710			0,4		

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

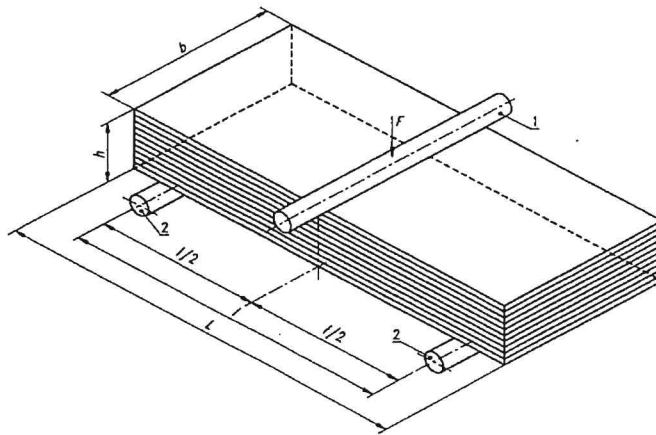
### Test method

- The test has been performed in according to Standard EN 12372 "*Natural stone test methods – Determination of flexural strength under concentrated load*" - 2007.

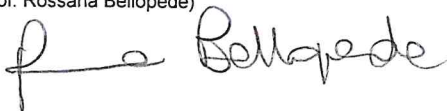
- The frost resistance test has been performed in according to Standard EN 12372 "*Natural stone test methods – Determination of frost resistance*" - 2010.

Date of testing: 2021/10/27

Load applied perpendicular to the planes of anisotropy.



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Distance between the supporting rollers mm 125

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 $\sigma$ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
1	25,0	50,0	1449	8,7			
2	25,0	50,1	1697	10,2			
3	24,9	50,1	1878	11,3			
4	25,2	50,1	1730	10,2			
5	24,9	50,2	1378	8,3	9,7	1,0	7,8
6	25,0	50,2	1549	9,3			
7	25,0	50,2	1688	10,1			
8	24,9	50,2	1423	8,6			
9	25,0	50,2	1820	10,9			
10	24,9	50,2	1578	9,5			

Distance between the supporting rollers = 125 mm

2) Specimens: 10 with 150 X 50 X 25 mm edges exposed to 56 frost cycles.

Specimen identi- fication number	Thickness h (mm)	Width b (mm)	Breaking load F (N)	Flexural strength $\sigma$ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
11	23,2	50,1	1297	9,0			
12	25,0	50,3	1381	8,2			
13	24,8	50,2	1736	10,5			
14	25,0	50,1	1578	9,4			
15	25,0	50,1	1229	7,4	9,0	1,2	6,7
16	24,8	50,1	1742	10,6			
17	25,2	49,9	1610	9,5			
18	24,9	50,2	1475	8,9			
19	24,8	50,2	1158	7,0			
20	25,0	50,2	1613	9,6			

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## DETERMINATION OF UNIAXIAL COMPRESSIVE STRENGTH ON A SAMPLE IN NATURAL CONDITIONS

### Test method

- The test has been performed in according to Standard EN 1926: "Natural stone test methods – Determination of uniaxial compressive strength" 2007.
- The frost resistance test has been performed in according to Standard EN 12372 "Natural stone test methods – Determination of frost resistance" - 2010.

Date of testing: 2021/11/24

Load applied perpendicular to the planes of anisotropy.

- Specimens: 10 cubes with 70 mm edge in natural conditions.

Specimen identification number	Side a (mm)	Side b (mm)	Breaking load (N)	Compressive strength $\sigma$ (MPa)				
				Individual values	Mean value	Standard Dev.	Coeff. of variation [n]	Minimum expected value
1	70	71	336	67,80				
2	71	71	436	86,69				
3	71	69	329	67,53				
4	71	70	343	68,96				
5	70	71	344	70,05				
6	71	72	435	86,38	75	9	0,12	58
7	72	70	338	66,38				
8	71	62	355	80,99				
9	71	62	374	85,24				
10	71	62	301	68,57				

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## DETERMINATION OF THE ABRASION RESISTANCE

### Test method

- The test has been performed in according to Standard EN 14157: "Natural stone test methods - Determination of the abrasion resistance" 2017.

Date of testing: 2021/11/17

Specimens: 6 with 150 x 150 x 20 mm edges.

Specimen identification number	Length of the groove (corrected) (mm)	Mean value of abrasion resistance (mm)	Standard Deviation	Maximum expected value (approx to 0,5)
1	22,5			
2	22,0			
3	22,5			
4	23,0	22,5	0,3	23,5
5	22,5			
6	22,5			

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## DETERMINATION OF THE SLIP RESISTANCE BY MEANS OF THE PENDULUM TESTER

### Test method

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

Date of testing: 2021/11/10

### Specimens with polished surface finish

- Specimens: 6 slabs with 200 x 200 x 20 mm edge.

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	41				5			
2	45				2			
3	40	42	2,0	38	10	5	3,2	1
4	41				5			
5	43				2			
6	44				8			

The mean slip resistance value SRV wet is less then 35

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## DETERMINATION OF RESISTANCE TO AGEING BY THERMAL SHOCK

### Test method

- The test has been performed according to Standard EN 14066 "*Natural stone test methods – Determination of resistance to ageing by thermal shock*" - 2013.

### Visual analysis of specimens after thermal shock

At the end of thermal shock cycles no difference are visible between specimens tested and reference specimen.

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NAMED CREMO DELICATO COMING FROM CAVA CREMOMARMI SRL N.113  
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**Determination of flexural strength under concentrated load on a sample in natural conditions and a sample exposed to thermal shock.**

Distance between the supporting rollers mm 125

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 $\sigma$ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
1	25,0	50,0	1449	8,7			
2	25,0	50,1	1697	10,2			
3	24,9	50,1	1878	11,3			
4	25,2	50,1	1730	10,2			
5	24,9	50,2	1378	8,3			
6	25,0	50,2	1549	9,3	9,7	1,0	7,8
7	25,0	50,2	1688	10,1			
8	24,9	50,2	1423	8,6			
9	25,0	50,2	1820	10,9			
10	24,9	50,2	1578	9,5			

1) Specimens: 10 with 150 x 50 x 25 mm edges exposed to thermal shock.

Specimen identi- fication number	Thickness h (mm)	Width b (mm)	Breaking load F (N)	Flexural strength $\sigma$ (MPa)			
				Individual values	Mean value	Standard Dev.	Minimum expected value
21	25,1	50,2	1129	6,7			
22	24,9	50,2	1229	7,4			
23	24,8	50,2	1052	6,4			
24	24,9	50,2	791	4,8			
25	24,9	50,2	1246	7,5			
26	24,9	50,1	752	4,5	6,5	1,3	4,1
27	24,9	50,2	1223	7,4			
28	24,9	50,1	942	5,7			
29	24,9	50,2	975	5,9			
30	24,9	50,1	1394	8,4			

Flexural strength on the sample in natural conditions (mean value)

9,7 MPa

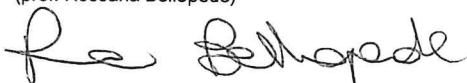
Flexural strength on the sample exposed to thermal shock (mean value)

6,5 MPa

Variation of flexural strength

-33,4 %

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DETERMINATION OF PHYSICAL AND MECHANICAL PROPERTIES ON A SAMPLE OF NATURAL STONE NAMED CREMO DELICATO COMING FROM CAVA CREMOMARMI SRL N.113 REQUIRED BY MARMI DI VARA SRL

TABLE OF RESULTS

Petrographic examination - definition		marble		
		U.M.	mean val.	st. dev.
Water absorption at atmospheric pressure		%	0,11	0,01
Apparent density		kg/m <sup>3</sup>	2710	0
Open porosity		%	0,4	0,0
Flexural strenght under concentrated load	in natural conditions	MPa	9,7	1,0
Frost resistance	after 56 frost cycles	MPa	9,0	1,2
Compressive strenght	in natural conditions	MPa	75	9
Frost resistance	after 56 frost cycles	MPa	n.a.	n.a.
Abrasion resistance		mm	22,5	0,3
Slip resistance	polished surface finish (dry)	SRV	42	2,0
	polished surface finish (wet)	SRV	5	3,2
Water absorption coefficient by capillarity			n.a.	n.a.
Thermal shock	ultrasound pulse velocity variation	%		
	flexural variation	%	-33	
Breaking load at dowel hole			n.a.	n.a.
Knoop hardness			n.a.	

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