



TEST REPORT

TEST FOR THE DETERMINATION OF THE DYNAMIC MODULUS OF ELASTICITY BY THE FREQUENCY OF RESONANCE METHOD

1 | Identification

Name	LNEC/DE/NESDE
Address	Av. do Brasil, 101 1700-166 LISBON
Customer/applicant's order reference	DED/NCTC'S CONTRIBUTION TO THE "COLLECTION AND CONDUCT OF MECHANICAL CHARACTERISATION TESTS ON BEDDING MORTARS"

2 | Samples and sampling procedure

The sample of masonry mortar was taken on site by a technician from LNEC's Wall Coverings Unit (URPa) on 26 November 2025 at 09:30 am. The consistency of the sample was determined according to the standard EN 1015-3:1999 – Methods of test for mortar for masonry - Part 3: Determination of consistency of fresh mortar (by flow table) and the bulk density was assessed in accordance with standard EN 1015-6:1998 – Methods of test for mortar for masonry - Part 6: Determination of bulk density of fresh mortar. The sample was then cast into three metal moulds, each with three cavities measuring 160 mm × 40 mm × 40 mm, resulting in a total of nine test specimens. The average dimensions of the test specimens were 160.13 mm × 40.01 mm × 40.14 mm, intended for the tests to determine the dynamic modulus of elasticity by the frequency of resonance method. The sample and specimens' identification is presented in Table 2.1.

Table 2.1 – Identification of the sample and test specimens

Sample description	Quantity	Test specimens
R4-M5-0%	6 kg	R4-M5-0%_1 to 9

3 | Tests carried out/Test conditions

3.1 Test Method

The dynamic modulus of elasticity determination test by the frequency of resonance method was carried out at 7, 28 and 60 days of curing time at the Wall Coverings Unit (URPa) of LNEC, in accordance with the specifications of the standard NP EN 14146:2006 – Test methods for natural stone - Determination of the dynamic modulus of elasticity (by measuring the fundamental resonance frequency).

Before testing, the specimens were placed at a temperature of 20 °C (+3 / -2 °C) and a relative humidity of 95 ± 5% for 48 hours. They were then demoulded and kept in the same conditions for an additional period of five days.



TEST REPORT

After this period, the specimens were placed at a temperature of 20 °C (+3 / -2 °C) and a relative humidity of $65 \pm 5\%$. They were then subjected to dynamic modulus of elasticity tests at the specified curing times.

For the determination of the dynamic modulus of elasticity test by the frequency of resonance method, a Zeus ZRM 2005 equipment was utilized.

4 | Results

Table 4.1 shows the dynamic modulus of elasticity, determined using the frequency of resonance method, values obtained at the curing times of 7, 28 and 60 days.

**Table 4.1 – Values obtained for the dynamic modulus of elasticity
by the frequency of resonance method**

Curing time	Specimens	Bulk Density (kg/m ³)	Frequency (Hz)	Dynamic Modulus of Elasticity (GPa)
7 days	R4-M5-0%_1	1957	3821	2.93
	R4-M5-0%_2	1945	3744	2.80
	R4-M5-0%_3	1946	3915	3.06
	Average	1950	3827	2.93
	Standard deviation	± 6	± 86	± 0.13
28 days	R4-M5-0%_4	1700	4975	4.32
	R4-M5-0%_5	1701	4940	4.26
	R4-M5-0%_6	1694	4894	4.16
	Average	1698	4936	4.25
	Standard deviation	± 4	± 41	± 0.08
60 days	R4-M5-0%_7	1690	4642	3.73
	R4-M5-0%_8	1684	4739	3.88
	R4-M5-0%_9	1691	4729	3.87
	Average	1688	4703	3.83
	Standard deviation	± 4	± 54	± 0.08

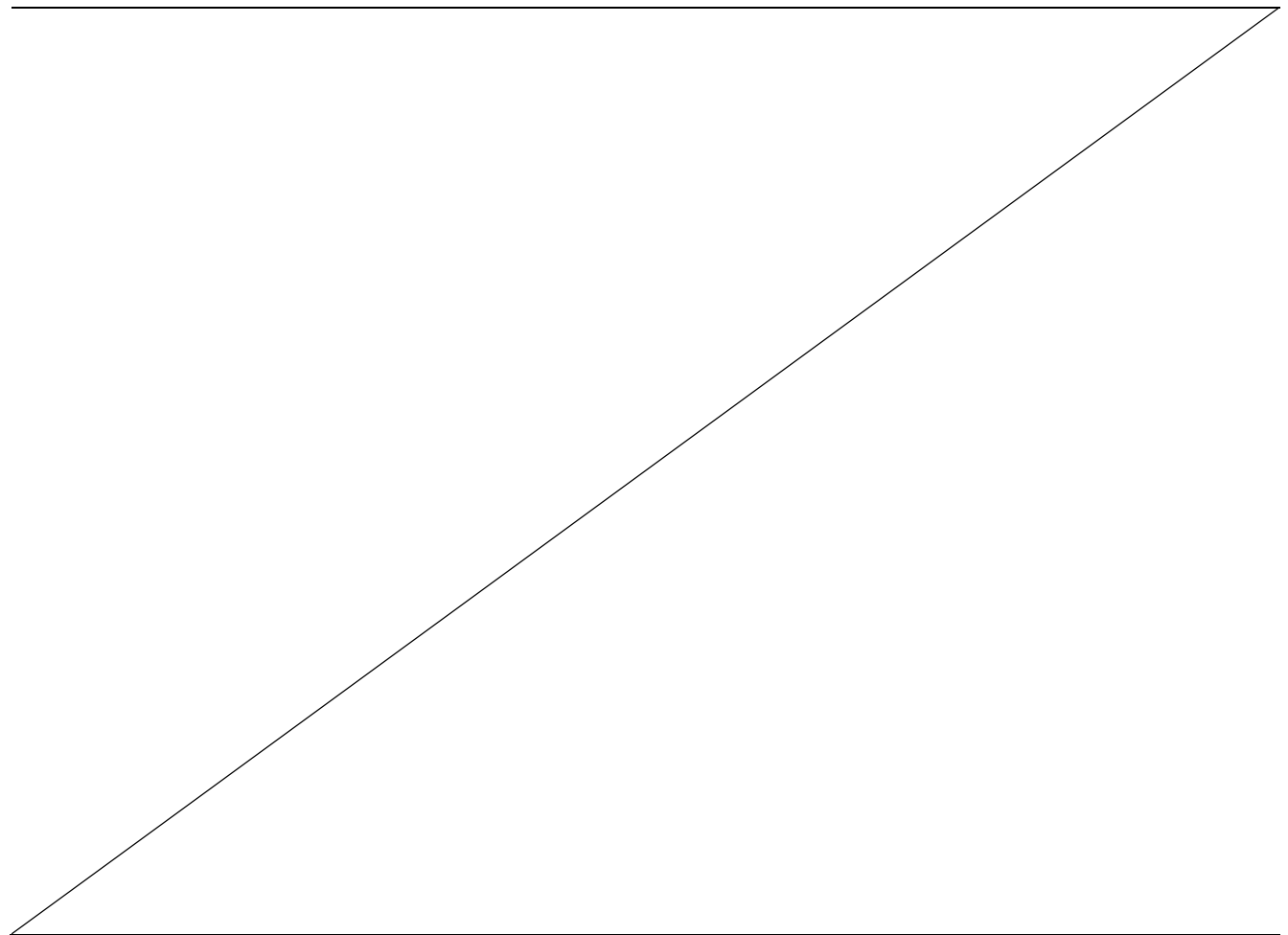


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TEST REPORT

5 | Comments

The results obtained in this test are part of the study on the mechanical characterisation of mortars conducted for LNEC/DE/NESDE.



Lisbon, LNEC, 27 March 2026

TESTED BY

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