



# 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 3 December 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 160.38 mm × 40.24 mm × 40.38 mm, intended for the tests to determine the 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
R5-M5-0%	6 kg	R5-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 14, 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.



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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 14, 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 <sup>3</sup> )	Frequency (Hz)	Dynamic Modulus of Elasticity (GPa)
14 days	R5-M5-0%_1	1753	4646	3.88
	R5-M5-0%_2	1755	4741	4.08
	R5-M5-0%_3	1716	4732	3.95
	<b>Average</b>	<b>1741</b>	<b>4706</b>	<b>3.97</b>
	<b>Standard deviation</b>	<b>± 22</b>	<b>± 53</b>	<b>± 0.10</b>
28 days	R5-M5-0%_4	1677	4879	4.10
	R5-M5-0%_5	1693	5056	4.42
	R5-M5-0%_6	1704	5092	4.53
	<b>Average</b>	<b>1691</b>	<b>5009</b>	<b>4.35</b>
	<b>Standard deviation</b>	<b>± 14</b>	<b>± 114</b>	<b>± 0.22</b>
60 days	R5-M5-0%_7	1699	4952	4.25
	R5-M5-0%_8	1692	4965	4.31
	R5-M5-0%_9	1648	4783	3.89
	<b>Average</b>	<b>1680</b>	<b>4900</b>	<b>4.15</b>
	<b>Standard deviation</b>	<b>± 28</b>	<b>± 102</b>	<b>± 0.23</b>

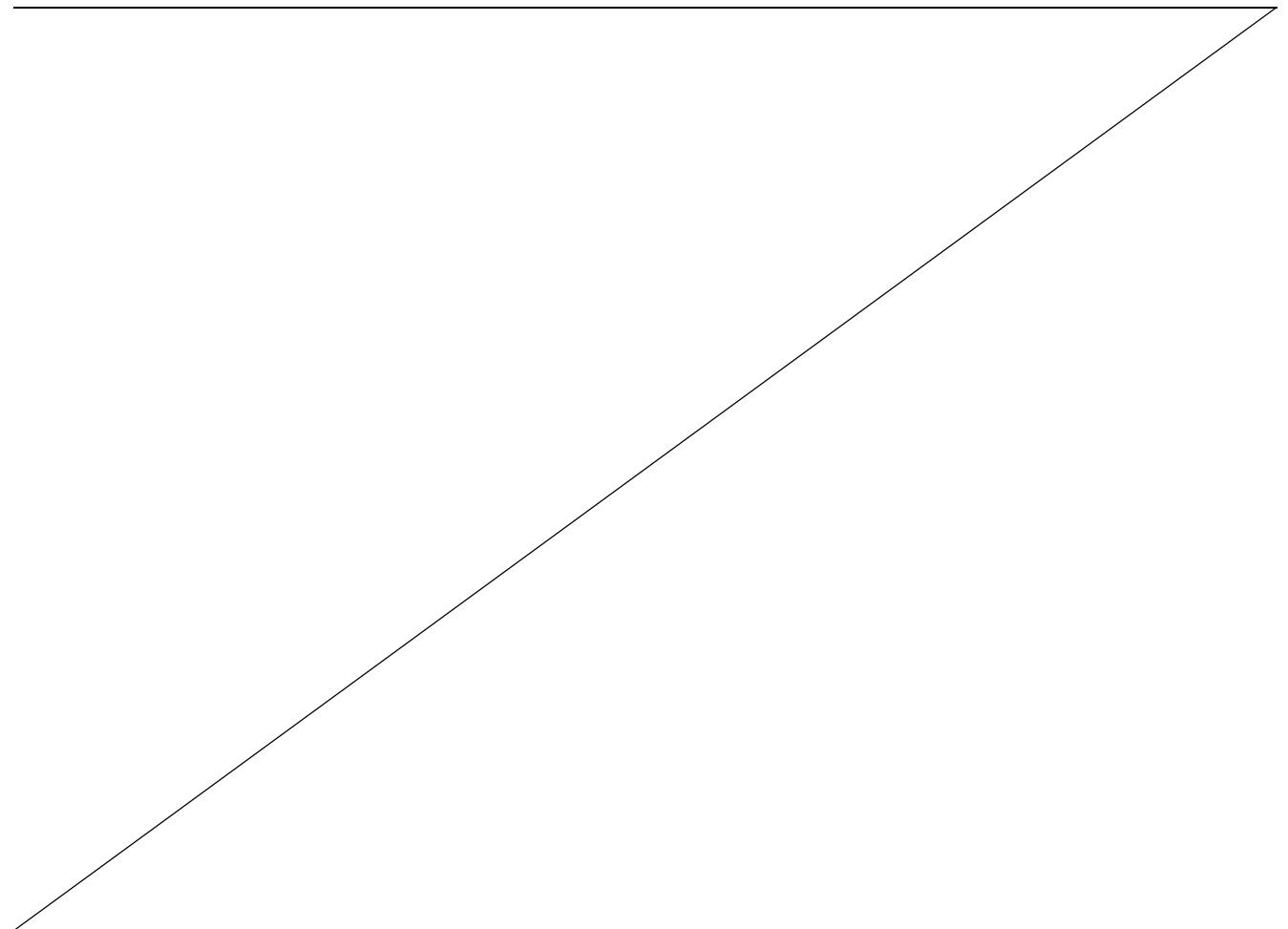


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## 5 | Comments

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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