

EMMEDUE S.P.A.

Via Toniolo 39/B, Loc. Bellocchi, Fano (PU)

EXPERIMENTAL TESTING UPON THE INTEGRATED SYSTEM OF EMMEDUE MODULAR PANELS

REPORT ON TESTING FOR PANELS IN CYCLIC CONDITIONS

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1. Introduction

The company EMMEDUE, with Headquarters at No. 39/B Via Toniolo, Loc. Bellocchi, Fano (PU), which is interested in obtaining the technical pass certificate for an integrated system of modular panels which it owns the legal rights to, has engaged Eucentre to perform the activities described below:

- Static testing upon 12 panels of reduced dimensions
- Static testing upon 8 floor elements
- Testing upon 8 true scale panels in cyclic conditions
- Tests upon 4 junctions
- Dynamic test upon a 1:1 scale building
- Evaluation of the results obtained
- Support for requesting and obtaining technical pass certification

This report has been issued in relation to the static testing performed upon 8 true scale panels under cyclic conditions.



Figure 1: Test setup

2. Description of the tests

The tests were performed at the Materials and Structures Testing Laboratories of the Università degli Studi di Pavia.

The testing campaign is made up of near static tests upon the following panels:

Test No.	Dimensions [m]	Openings	Axial load [kN]
1	3.00 x 3.00	none	150
2	3.00 x 3.00	none	300
3	4.00 x 3.00	none	150
4	4.00 x 3.00	none	300
5	3.00 x 3.00	window	150
6	3.00 x 3.00	window	300
7	3.00 x 3.00	door	150
8	3.00 x 3.00	door	300

The cyclical panel tests were carried out using an MTS 244.41 type actuator with the following technical specifications:

Dynamic force (at 197 bar)	500 kN
Piston area	248.28 cm ²
Rod diameter	133.4 mm
Maximum static stroke	508.0 mm
Maximum dynamic stroke	508.0 mm

SONY SR50 050° position sensors were employed to check the hydraulic jacks

3. Description of the instrumentation

The National Instruments data acquisition system is made up of a 24bit resolution analogical digital converter with a maximum sampling rate of 300kS, assembled with an SCXI1001 chassis multiplexer with SCXI1102B acquisition modules for potentiometers and thermocouples.

PZ-12-A-050 and PZ-12-A-250 Gefran rectilinear position transducers with the following technical specifications were employed:

	PZ-12-A-050	PZ-12-A-250
Useful Electrical Stroke (C.E.U.)	50 mm	250 mm
Independent Linearity (within the C.E.U.)	+/- 0.1%	+/- 0.05%
Movement speed	• 10 m/s	• 10 m/s
Movement force	• 0.5 N	• 0.5 N
Theoretical Electrical Stroke (C.E.T.)	51 mm	251 mm
Mechanical Stroke (C.M.)	55 mm	255 mm
Resistance (on the C.E.T.)	2 k•	6 k•
Dissipation at 40°C (0W at 120°C)	1 W	3 W
Maximum applicable voltage	20 V	60 V

The acquisition software was produced by the laboratory in a Labview programming environment (Figure 2).

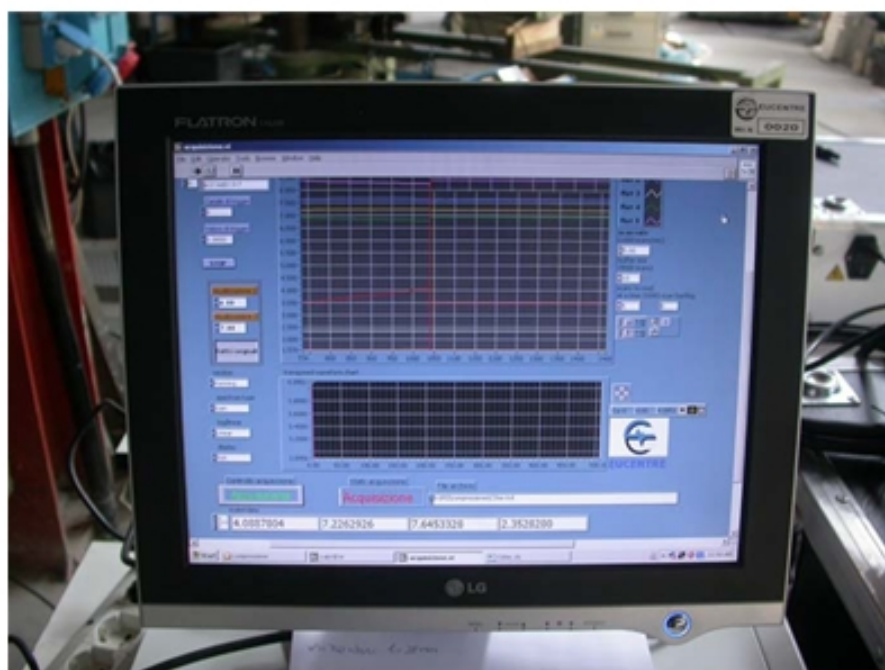


Figure 2: Data Acquisition program screenshot

3.1 Tests on panels without openings L=3m

The instrumentation was made up of 26 potentiometers arranged as shown in Figure 3

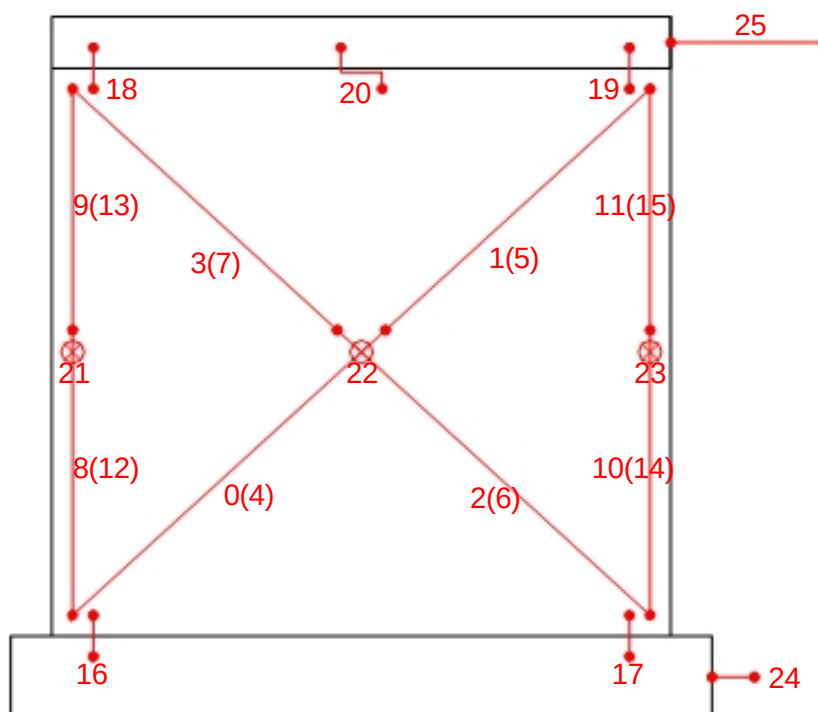


Figure 3: Instrumentation for 3m panels without openings

Base measurement lengths:

ch0-ch2-ch4-ch6	L=200cm
ch1-ch3-ch5-ch7	L=181cm
ch8-ch10-ch12-ch14	L=128.5cm
ch9-ch11-ch13-ch15	L=129cm

3.2 Tests on panels without openings L=4m

The instrumentation was made up of 27 potentiometers arranged as shown in Figure 4.

Base measurement lengths:

ch0-ch2-ch4-ch6	L=237cm
ch1-ch3-ch5-ch7	L=217cm
ch8-ch10-ch12-ch14	L=127cm
ch9-ch11-ch13-ch15	L=127.5cm

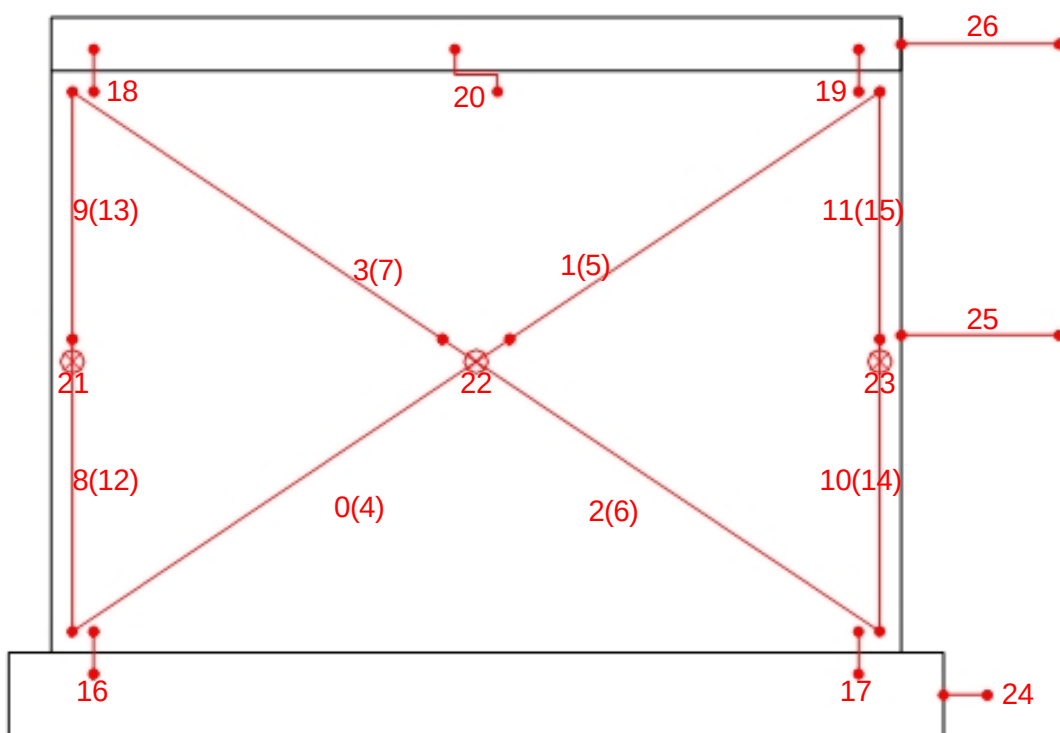


Figure 4: Instrumentation for 4m panels without openings

3.3 Tests on panels with windows

The instrumentation was made up of 24 potentiometers arranged as shown in Figure 5

Base measurement lengths:

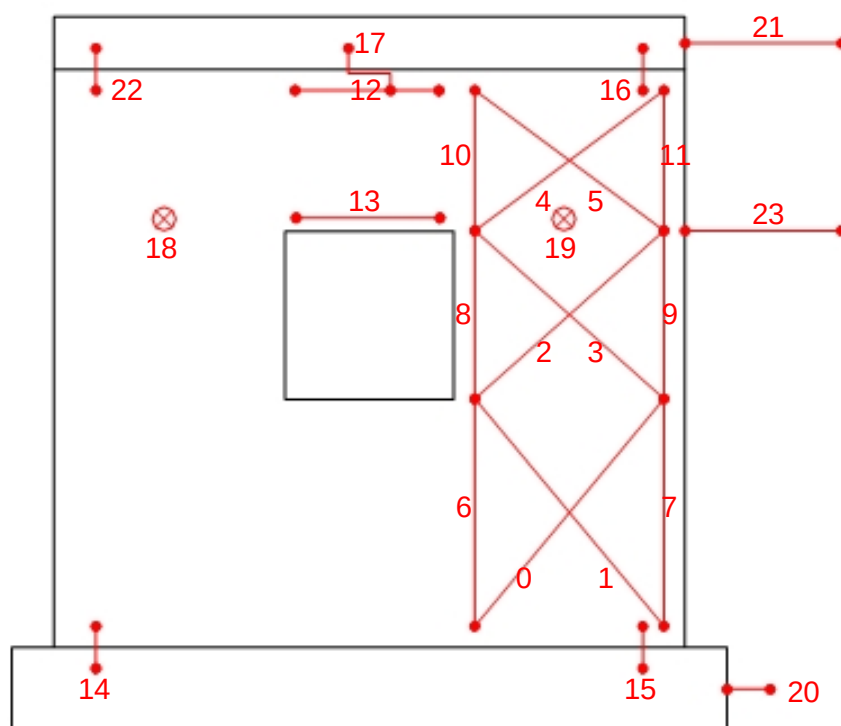


Figure 5: Instrumentation for panels with windows

Base measurement lengths:

ch0-ch1	L=129cm
ch2-ch3	L=135cm
ch4-ch5	L=80.5cm
ch6-ch7	L=106cm
ch8-ch9	L=113cm
ch10-ch11	L=34cm
ch12-ch13	L=124cm

The opening was centered and was 100x100 cm in size.

3.4 Tests on panels with doors

The instrumentation was made up of 23 potentiometers arranged as shown in Figure 6.

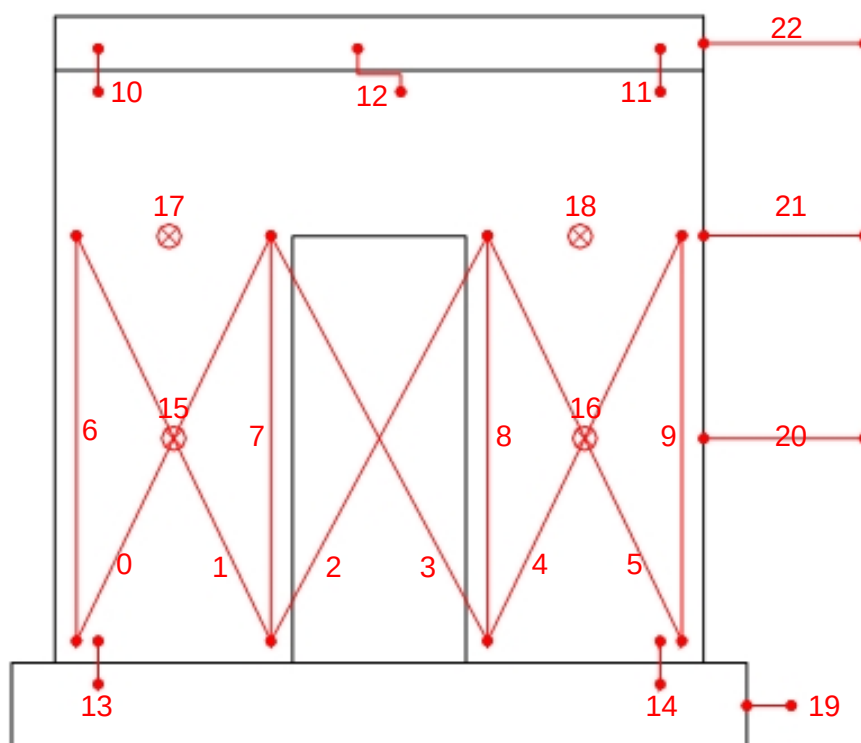


Figure 6: Instrumentation for panels with doors

Base measurement lengths:

ch0-ch1-ch4-ch5	L=216cm
ch2-ch3	L=224cm
ch6-ch7- ch8-ch9	L=106cm

The opening was centered and was 85x200H cm in size.

4. Description of the tested material

Emmedue offers an integrated system of modular panels whose structural functionality is guaranteed by two welded, galvanized steel nets, interconnected by means of double steel connectors, which contain a specially profiled polystyrene foam slab that is even capable of providing thermal and acoustic insulation.

In this testing campaign, the single Emmedue panel (Figure 7) was tested

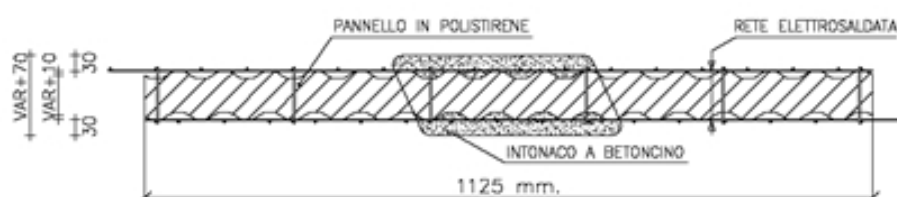


Figure 7: Single Emmedue Panel

5. Materials tests

Tests upon the concrete were performed in order to establish the actual characteristics of the materials. The results obtained are shown in the following table.

Compression resistance tests on samples of concrete for M2 floors					
Packaging date	Test date	Length [mm]	Width [mm]	Height [mm]	Resistance [N/mm ²]
18/09/07	05/12/07	40	40	80	54.0
18/09/07	05/12/07	40	40	80	53.1
18/09/07	05/12/07	40	40	80	51.0
18/09/07	05/12/07	40	40	80	48.8
18/09/07	05/12/07	40	40	80	52.9
18/09/07	05/12/07	40	40	80	53.8
18/09/07	05/12/07	40	40	80	49.0
18/09/07	05/12/07	40	40	80	52.5
18/09/07	05/12/07	40	40	80	51.5
18/09/07	05/12/07	40	40	80	53.0
18/09/07	05/12/07	40	40	80	52.6

18/09/07	05/12/07	40	40	80	53.8
Compression resistance tests on samples of concrete for M2 floors					
Packaging date	Test date	Length [mm]	Width [mm]	Height [mm]	Resistance [N/mm ²]
21/09/07	05/12/07	40	40	80	48.1
21/09/07	05/12/07	40	40	80	49.8
21/09/07	05/12/07	40	40	80	47.1
21/09/07	05/12/07	40	40	80	46.3
21/09/07	05/12/07	40	40	80	46.6
21/09/07	05/12/07	40	40	80	48.3
21/09/07	05/12/07	40	40	80	45.6
21/09/07	05/12/07	40	40	80	47.0
21/09/07	05/12/07	40	40	80	48.3
21/09/07	05/12/07	40	40	80	46.4
21/09/07	05/12/07	40	40	80	48.9
21/09/07	05/12/07	40	40	80	48.5
24/09/07	05/12/07	40	40	80	46.0
24/09/07	05/12/07	40	40	80	43.8
24/09/07	05/12/07	40	40	80	44.1
24/09/07	05/12/07	40	40	80	43.4
24/09/07	05/12/07	40	40	80	49.8
24/09/07	05/12/07	40	40	80	51.0
24/09/07	05/12/07	40	40	80	48.4
24/09/07	05/12/07	40	40	80	54.4
24/09/07	05/12/07	40	40	80	50.3
24/09/07	05/12/07	40	40	80	45.5
24/09/07	05/12/07	40	40	80	49.5
24/09/07	05/12/07	40	40	80	49.6
24/09/07	05/12/07	40	40	80	40.3
24/09/07	05/12/07	40	40	80	45.8
24/09/07	05/12/07	40	40	80	43.6
24/09/07	05/12/07	40	40	80	44.8
24/09/07	05/12/07	40	40	80	51.3
24/09/07	05/12/07	40	40	80	48.5

Compression resistance tests on samples of concrete for M2 floors					
Packaging date	Test date	Length [mm]	Width [mm]	Height [mm]	Resistance [N/mm ²]
24/09/07	05/12/07	40	40	80	38.8
24/09/07	05/12/07	40	40	80	44.6
24/09/07	05/12/07	40	40	80	40.5
24/09/07	05/12/07	40	40	80	43.8
24/09/07	05/12/07	40	40	80	42.4
24/09/07	05/12/07	40	40	80	44.0

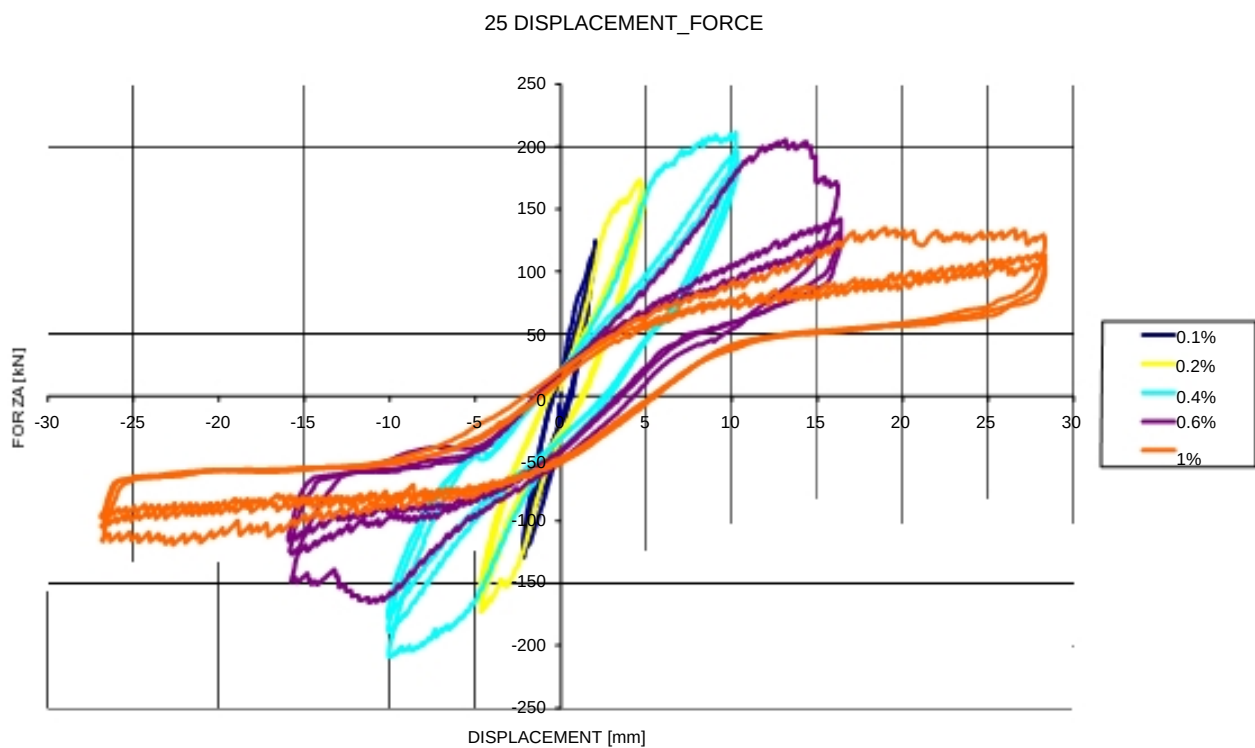
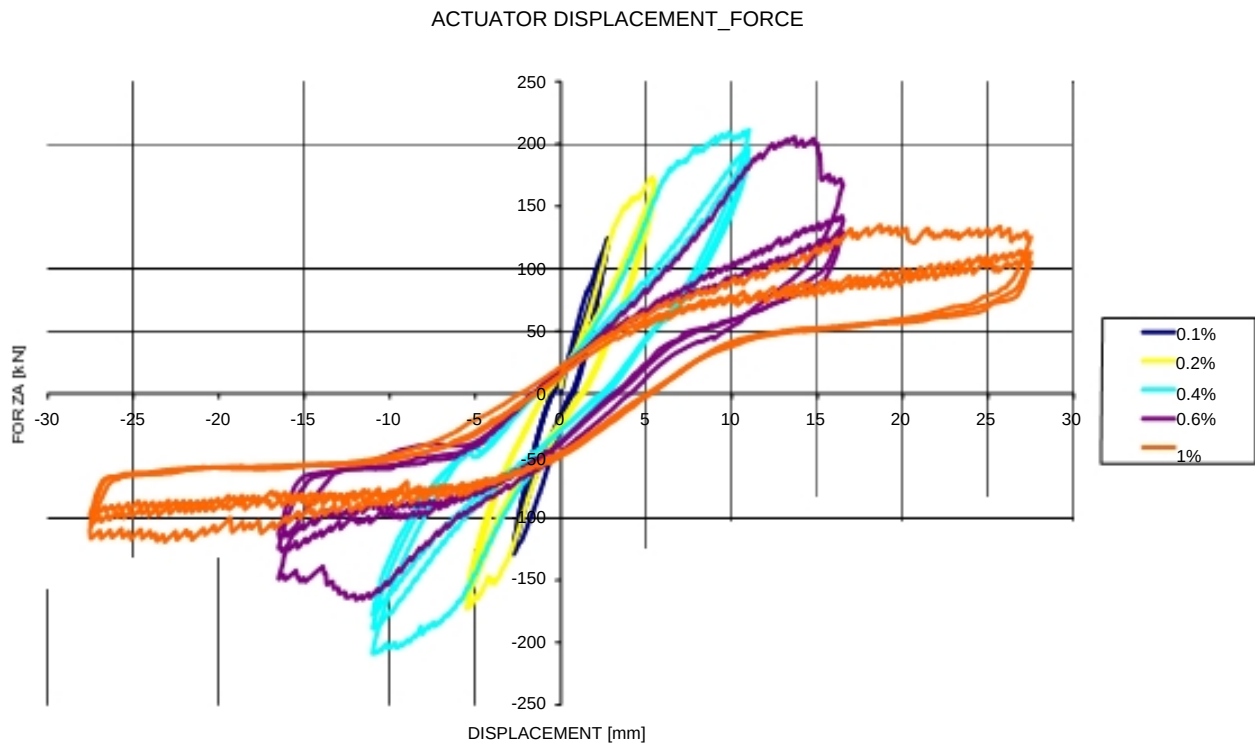
6. Results of the tests

Below are listed, for each test, the force displacement diagrams for the actuator and for the potentiometer upon the curb.

6.1 Tests on panels without openings L=3m

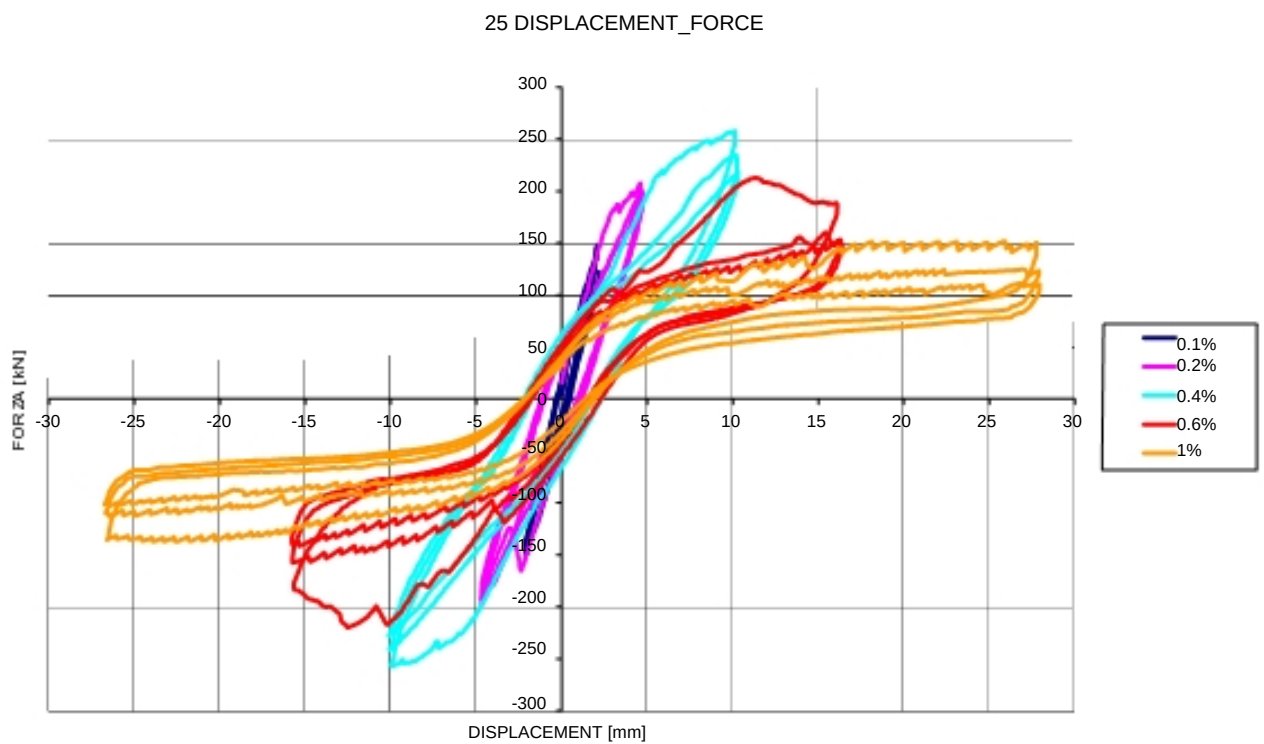
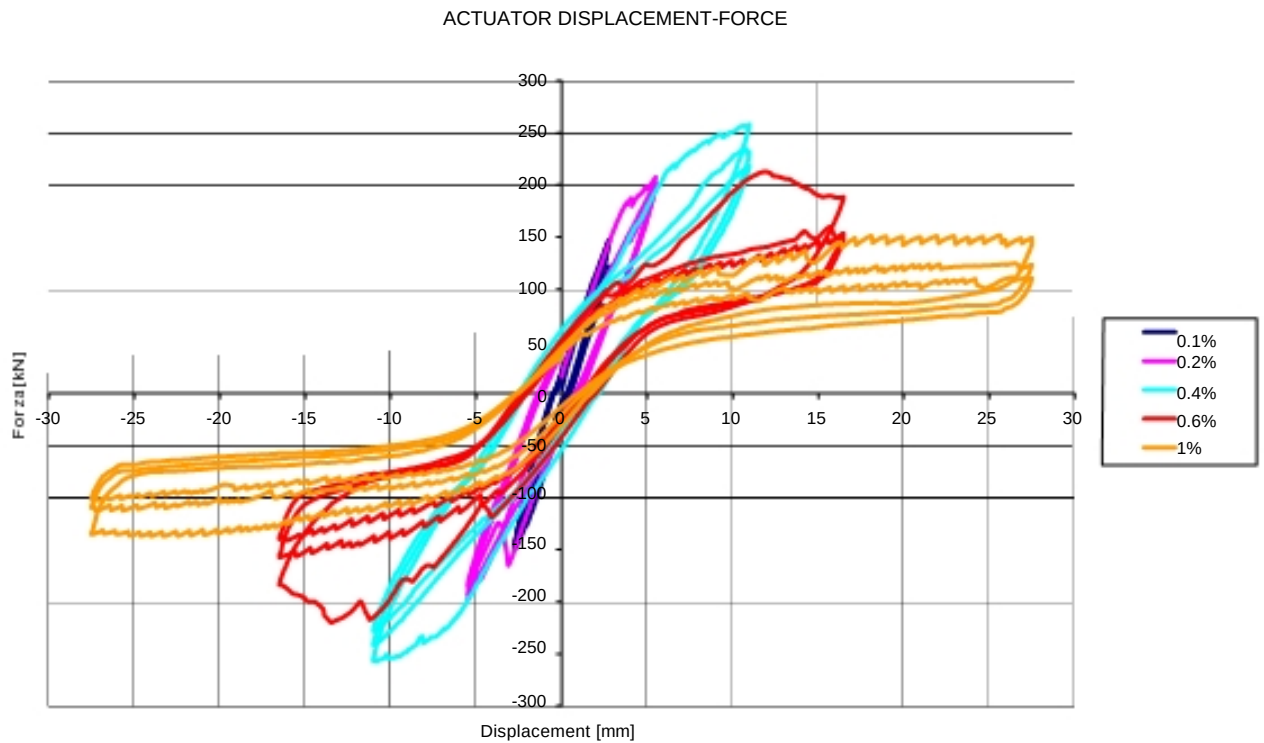
6.1.1 Test 1

Test performed on 06/05/08



6.1.2 Test 2

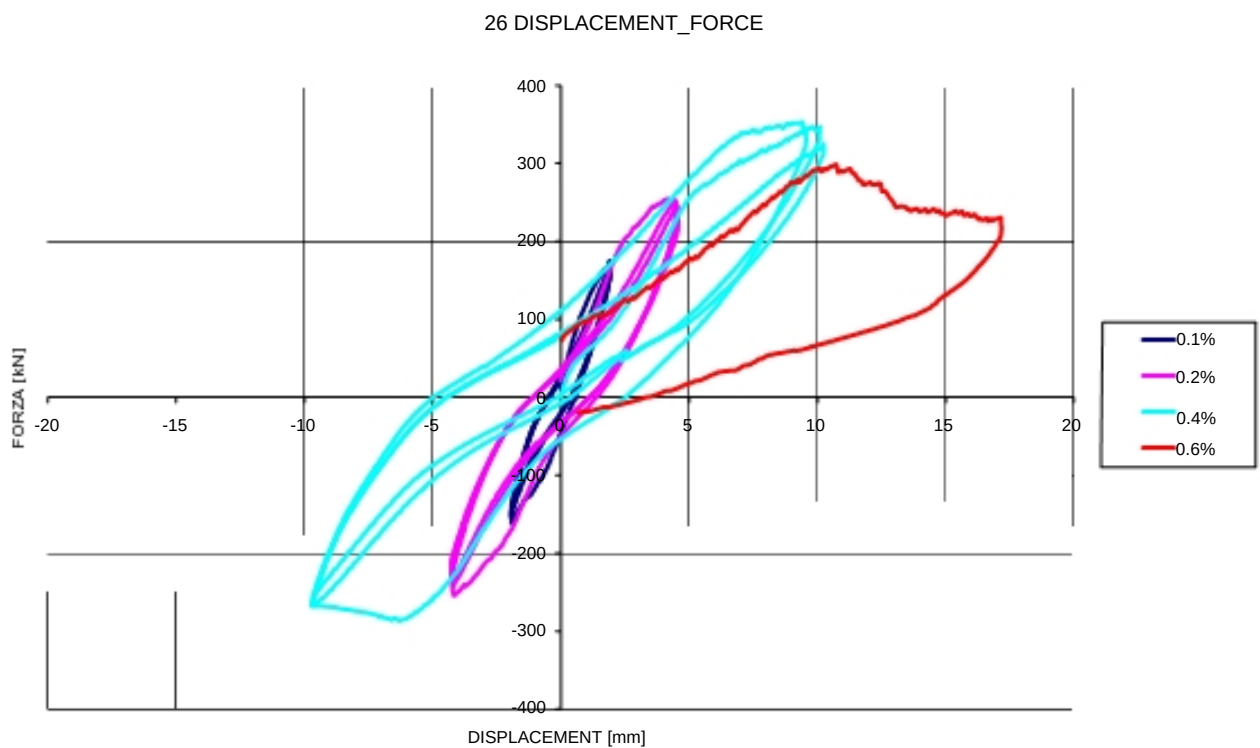
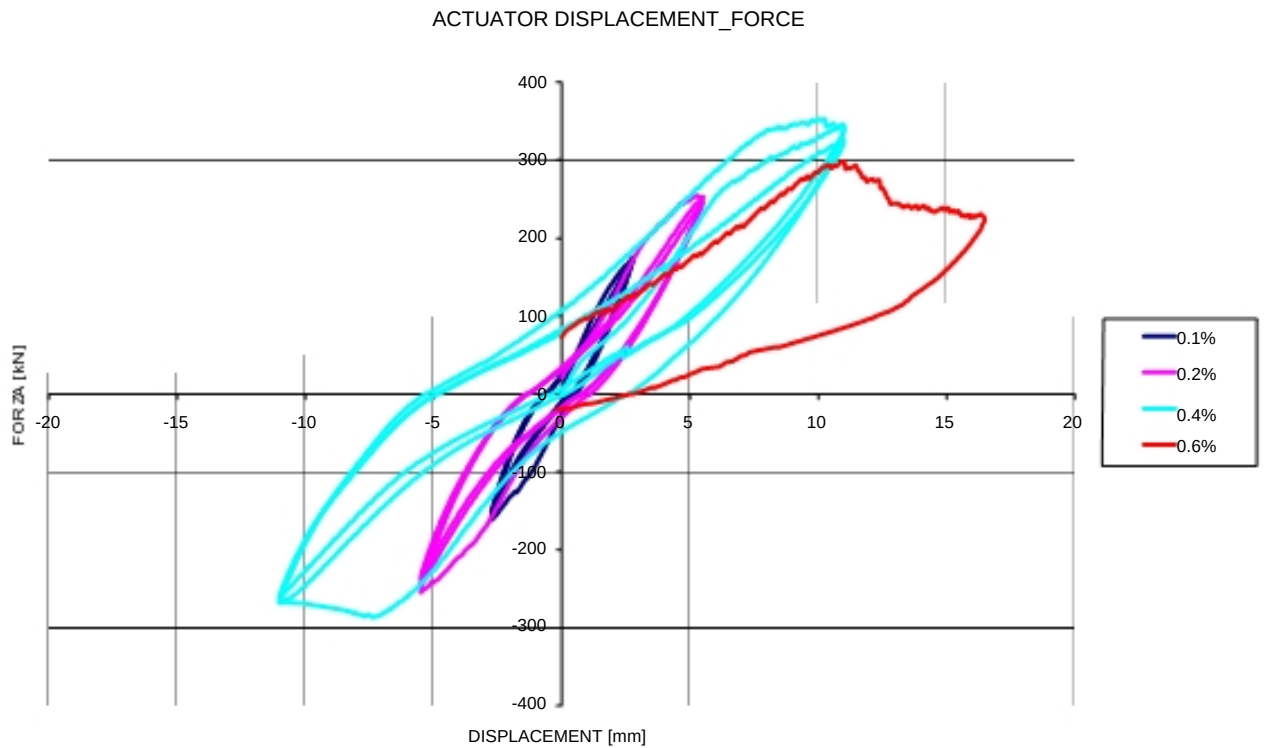
Test performed on 13/05/08



6.2 Tests on panels without openings L=4m

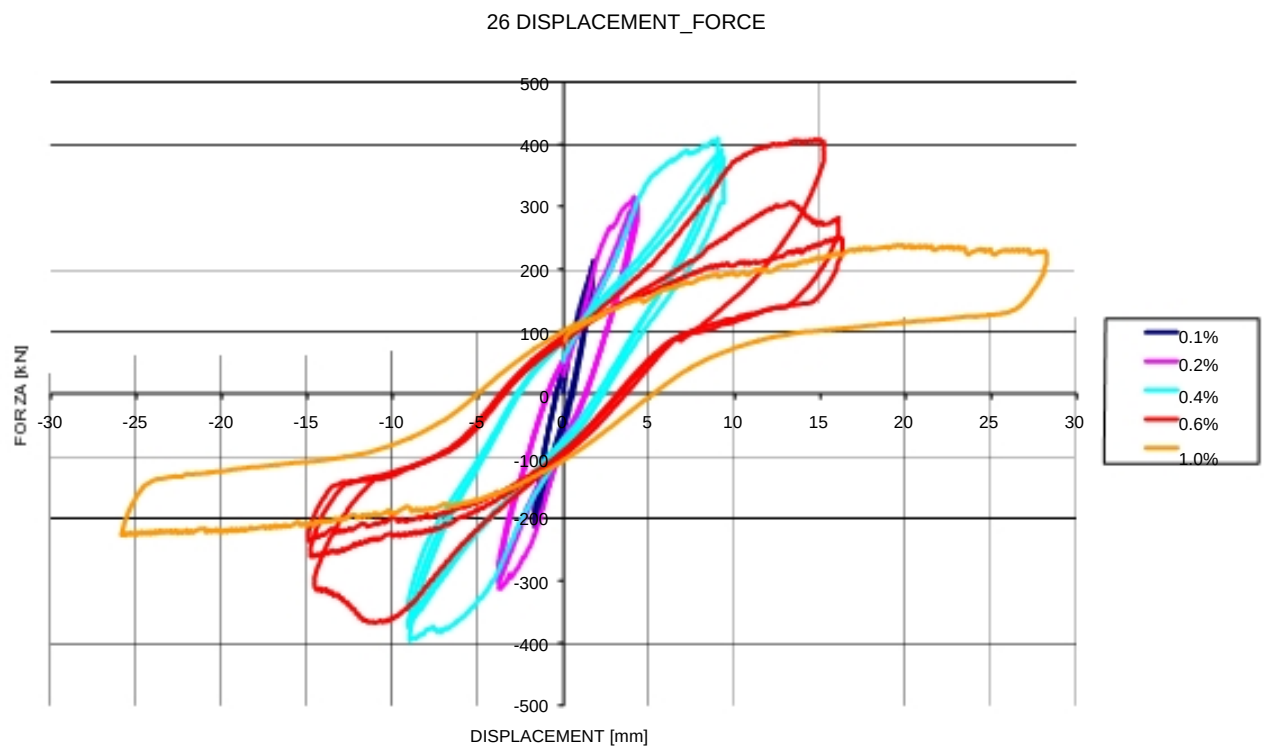
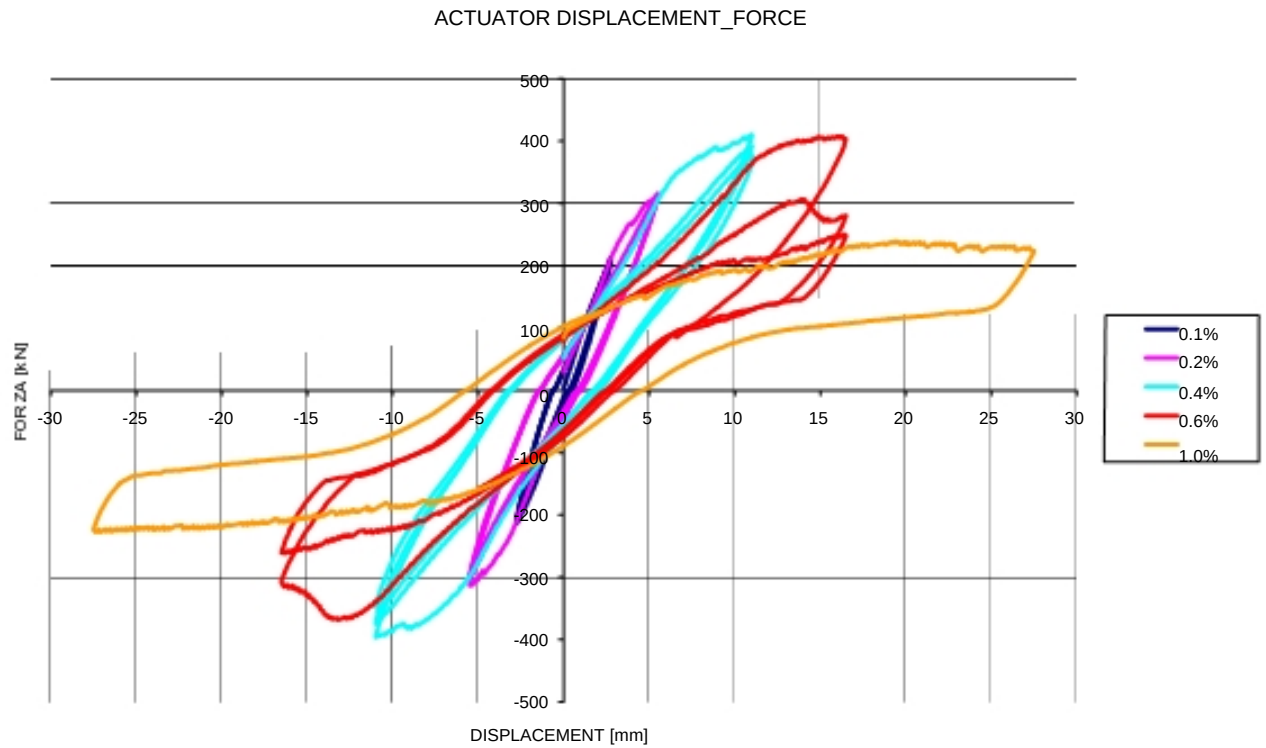
6.2.1 Test 3

Test performed on 02/10/08



6.2.2 Test 4

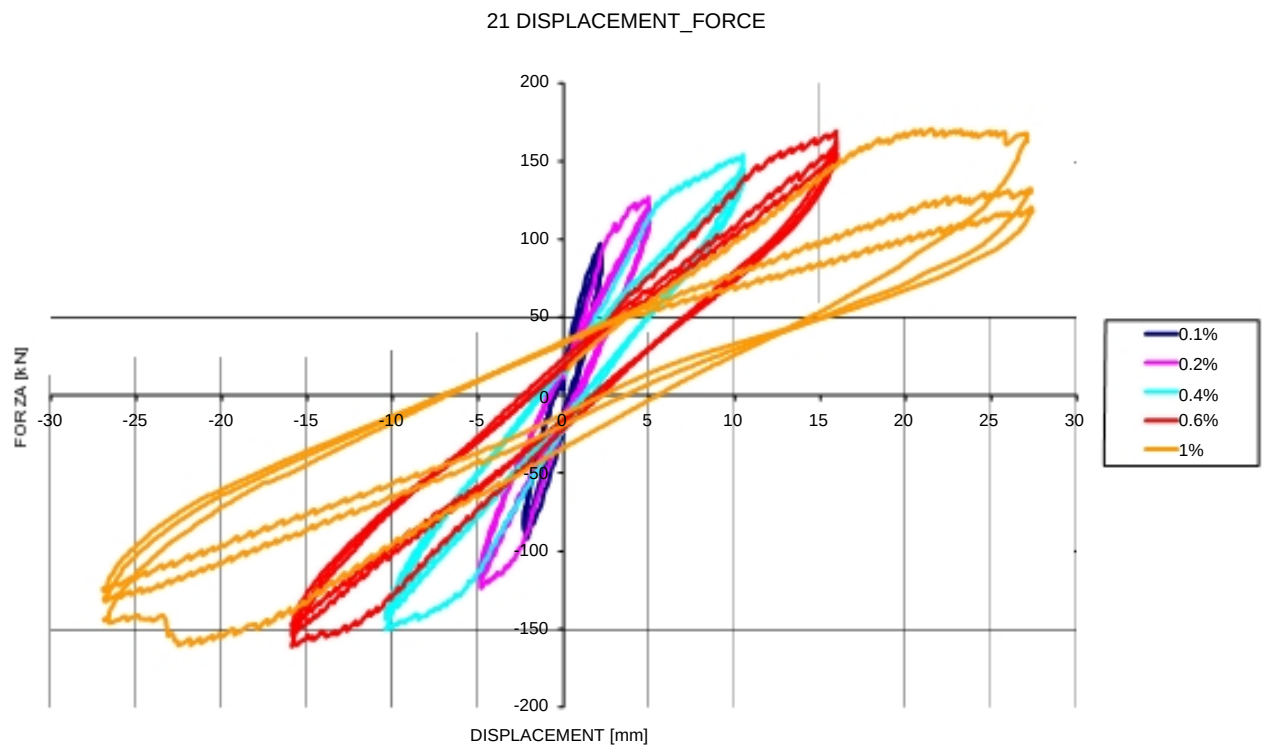
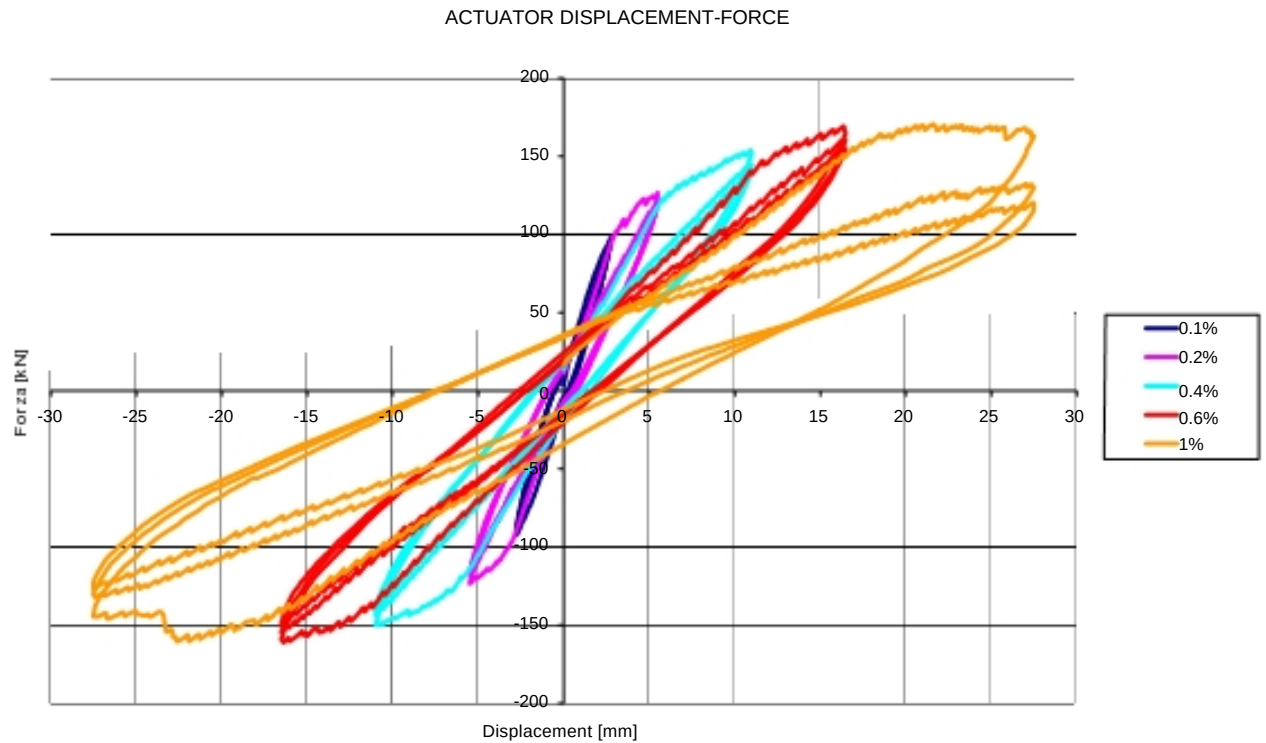
Test performed on 09/10/08



6.3 Tests on panels with windows

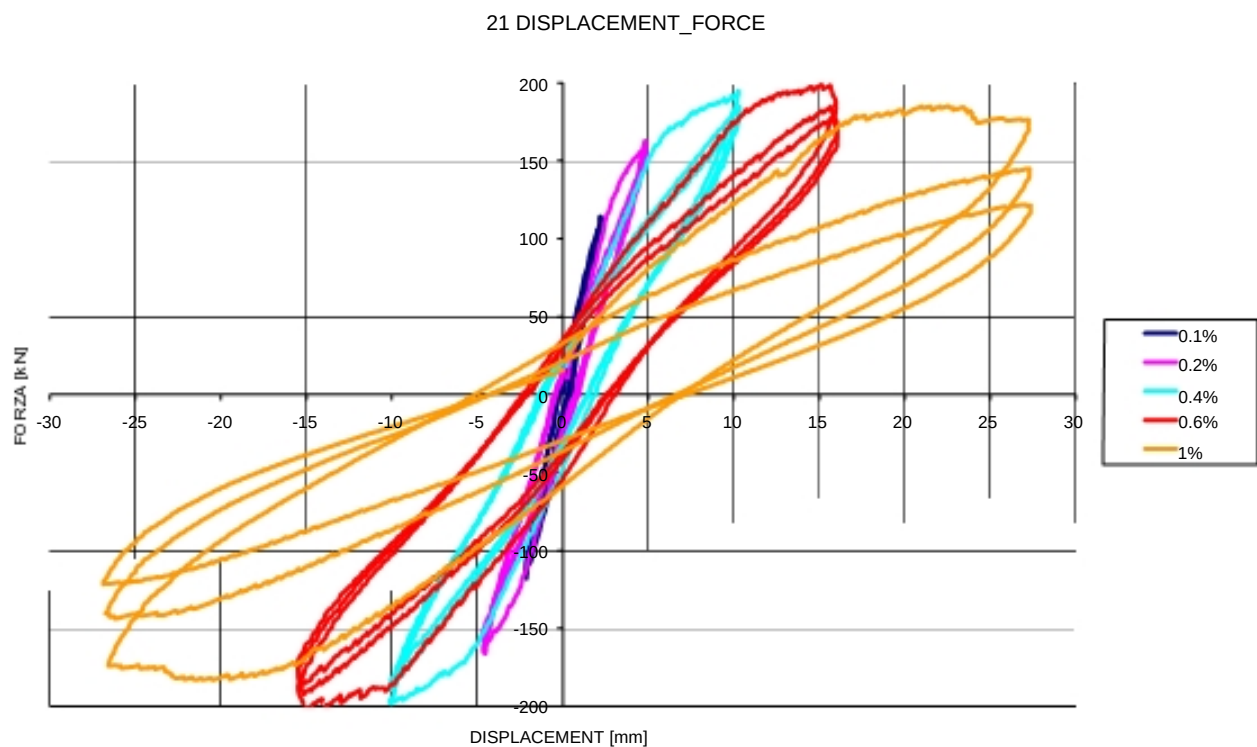
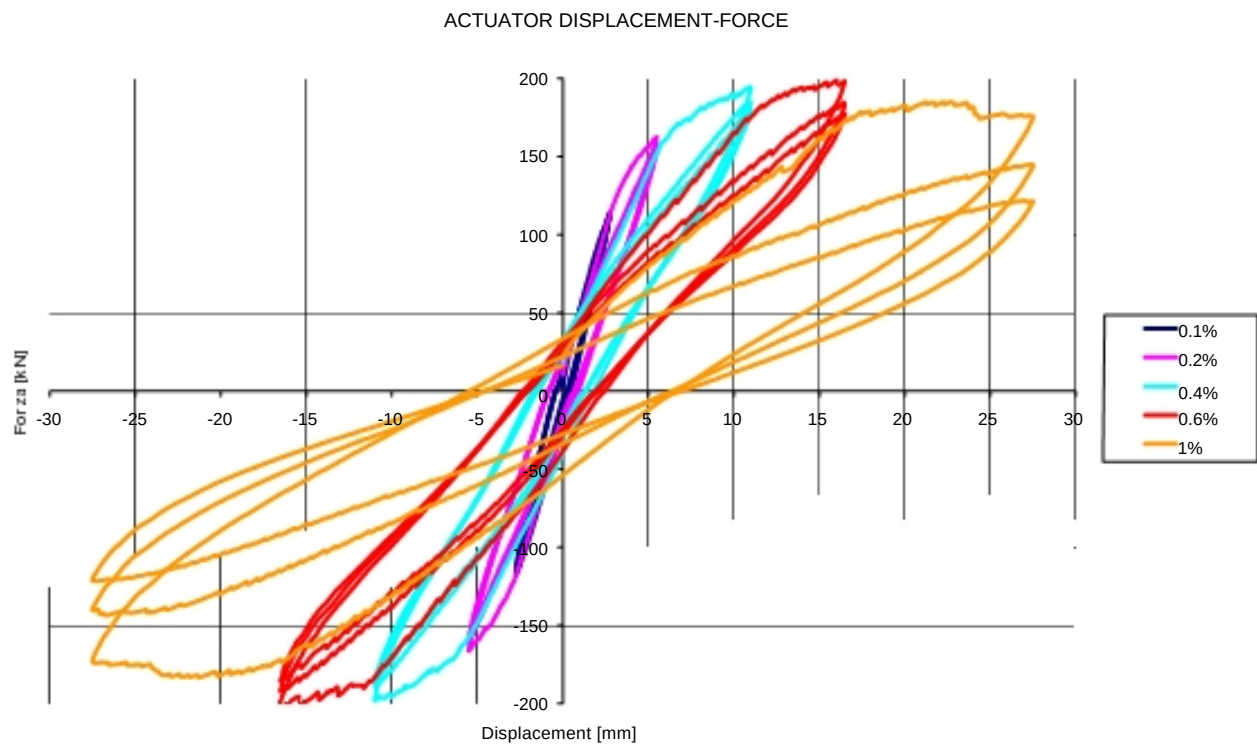
6.3.1 Test 5

Test performed on 12/06/08



6.3.2 Test 6

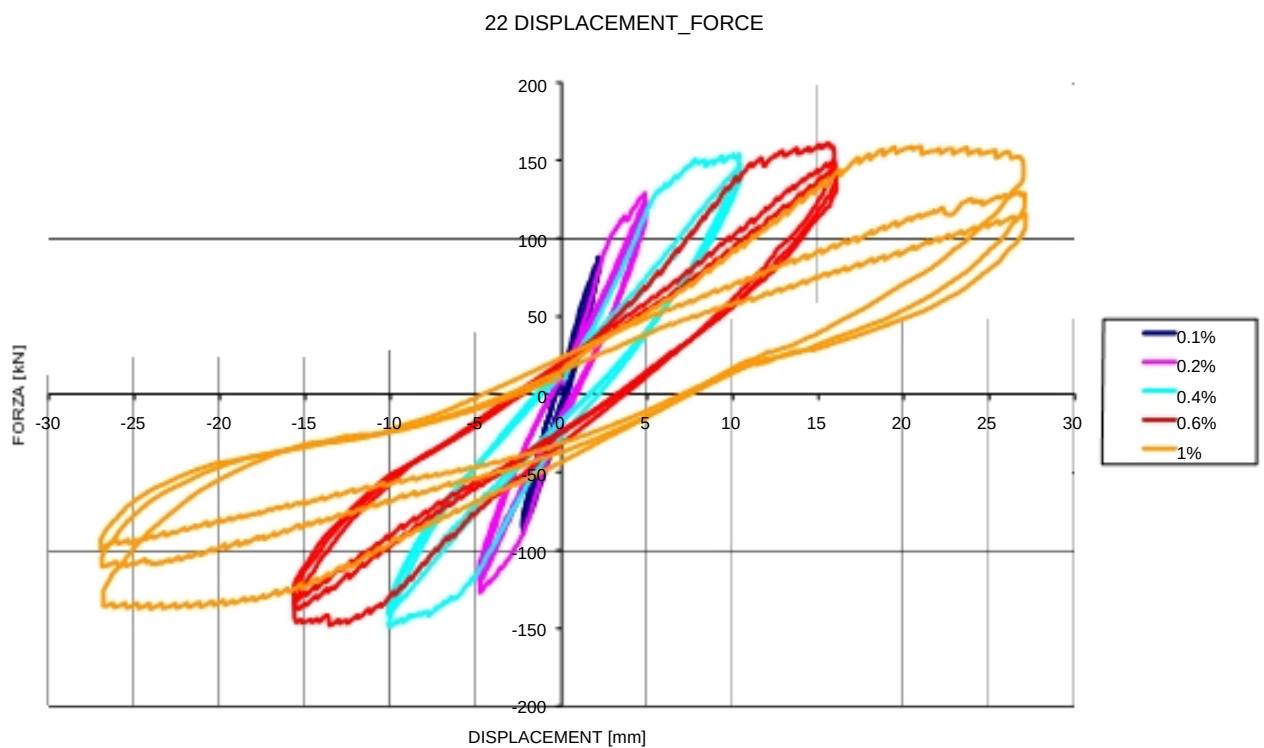
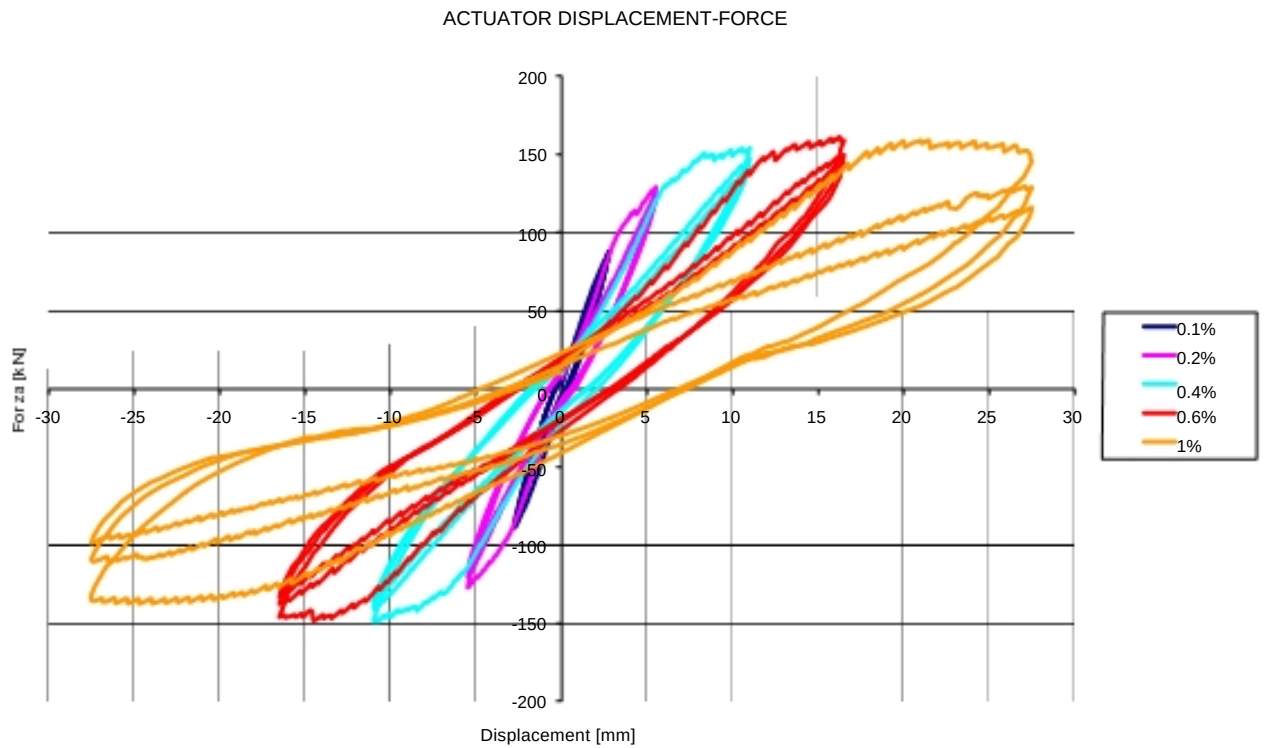
Test performed on 01/07/08



6.4 Tests on panels with doors

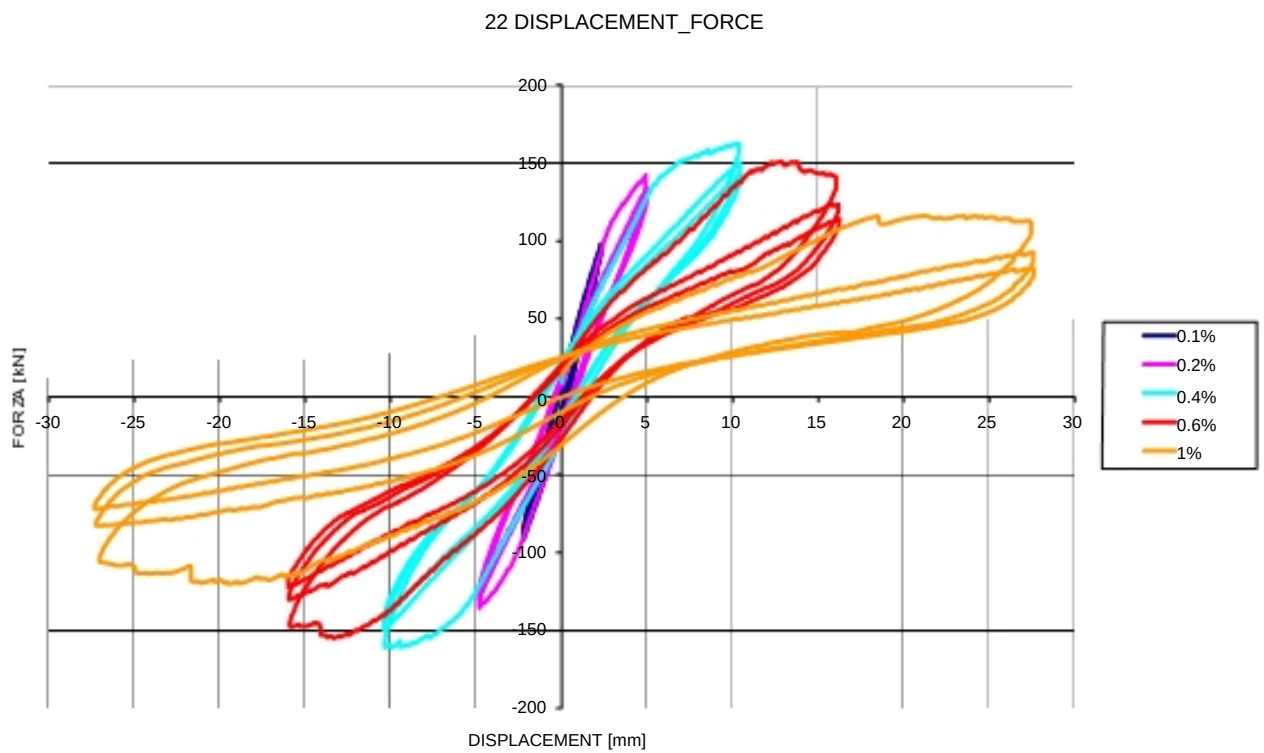
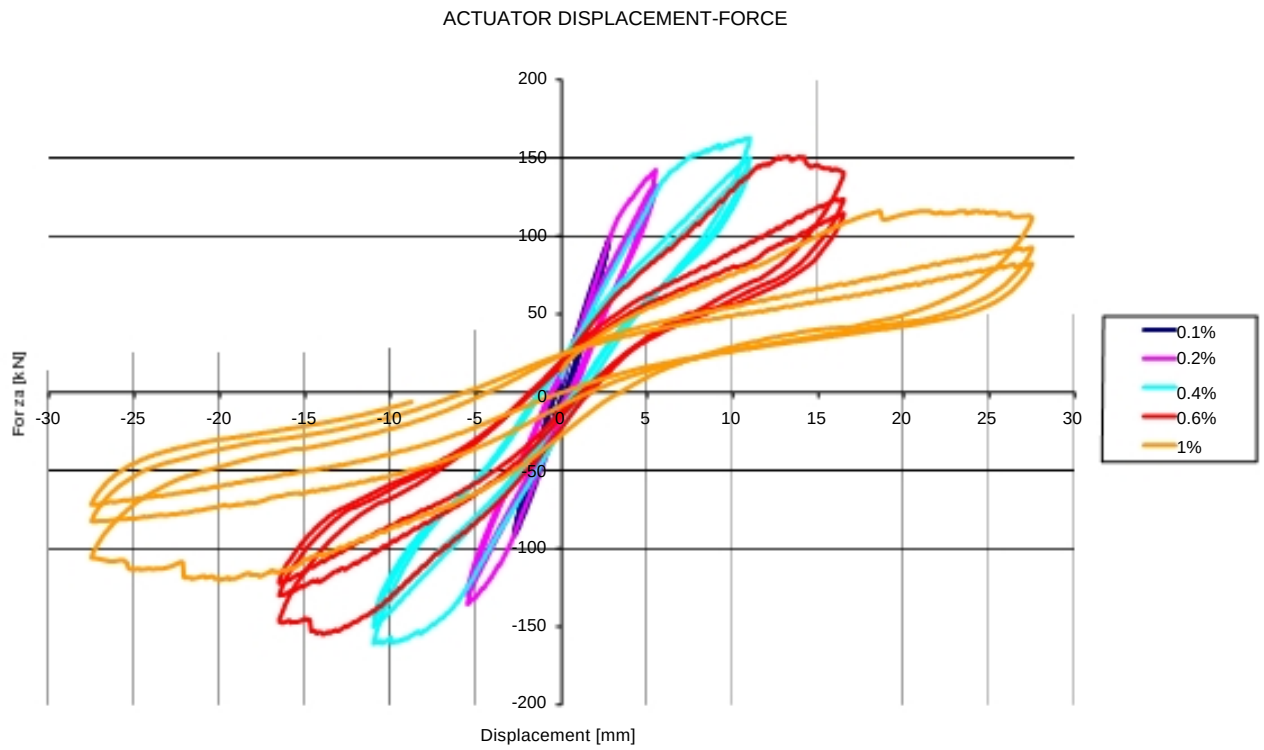
6.4.1 Test 7

Test performed on 27/05/08



6.4.2 Test 8

Test performed on 05/06/08



7. CD Contents

The CD contains the folders 1, 2, 3, 4, 5, 6, 7 and 8, regarding the respective tests.

Each folder contains a sub-folder called “ACQUIRED DATA” containing the files of text acquired during the test, a sub-folder called “ELABORATED DATA” containing files in Excel format, as well as a sub-folder called “PHOTOS” containing all of the photographs taken during the test.

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