EMMEDUE S.P.A. Via Toniolo 39/B, Loc. Bellocchi, Fano (PU)

EXPERIMENTAL TESTING UPON THE INTEGRATED SYSTEM OF EMMEDUE MODULAR PANELS

REPORT ON STATIC TESTING FOR FLOOR ELEMENTS

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In accordance with the current laws, the present report may not be reproduced or furnished to third parties nor utilized for purposes other than those for which it is intended without written authorization from the institution which possesses the rights to the document itself. 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
- Pseudo-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 floor elements.



Figure 1: Floor in its test configuration

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 floor elements:

- 2 elements of dimensions 2.25x4m with polystyrene thickness=8cm density 15 kg/m³
- 2 elements of dimensions 2.25x4m with polystyrene thickness=8cm density 25 kg/m³
- 2 elements of dimensions 2.25x5m with polystyrene thickness=16cm density 15 kg/m³
- 2 elements of dimensions 2.25x5m with polystyrene thickness=16cm density 25 kg/m³

The floor elements were tested with a simple support static scheme (Figure 2 and Figure 3), by means of a cylindrical-type constraint, with a net inflexion span equal to 3.50m and 4.50m respectively.



Figure 2: Floor Testing Scheme L=400cm



Figure 3: Floor Testing Scheme L=500cm

For the application of the load, as shown in the schemes from figures 1 and 2, a RARI Press model BS-1004-RO hydraulic jack with the following specifications was used:

100 t
680 bar
100 mm
153.28 cm ²
1532.8 cm ³
42 kg

A 350 bar Gefran model TFD pressure sensor with the following specifications was employed:

Range of measure	0-350 bar
Precision class	0.30% 0-60 bar
	0.25% 60-350 bar
Input impedance	4500 Ohm
Sensitivity	3 mV/V

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-100, PZ-12-A-50 and PZ-12-A-25 Gefran Rectilinear position transducers with the following specifications were employed:

	PZ-12-A- 100	PZ-12-A- 050	PZ-12-A- 025
Useful Electrical Stroke (C.E.U.)	100 mm	50 mm	25 mm
Theoretical Electrical Stroke (C.E.T.)	101 mm	51 mm	26mm
Mechanical Stroke (C.M.)	105 mm	55 mm	30 mm
Resistance (on the C.E.T.)	4 k•	2 k•	1 k∙
Independent Linearity (within the C.E.U.)	+/- 0.1%	+/- 0.1%	+/- 0.2%
Dissipation at 40°C (0W at 120°C)	1 W	1 W	3 W
Movement speed	• 10 m/s	• 10 m/s	• 10 m/s
Movement force	• 0.5 N	• 0.5 N	• 0.5 N
Maximum applicable voltage	60 V	40 V	20 V

The following instrumentation (Figure 4) was employed for each simply supported floor element:

- 10 potentiometers (stroke of 50 and 100mm) positioned along the span in order to measure the absolute movements

- 10 potentiometers (25mm stroke) positioned between the polystyrene layer, intended for measuring the crushing of the polystyrene and the separation of the two cls layers



Figure 4: Instrumentation positioning scheme

The acquisition software was produced by the laboratory in a Labview programming environment (Figure 5).



Figure 5: Data Acquisition program screenshot

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.

This testing procedure examined the single panel used as a disposable insulating formwork for floors of limited span, without designed ribbing.

The technical data sheet for the single Emmedue floor panel is shown below (Figure 6)



Figure 6: Single Emmedue floor panel

5. Materials tests

Tests upon the cement and 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 cubes of cls for M2 floors						
Packaging	Test	Length	Width	Height	Mass	Resistance
date	date	[mm]	[mm]	[mm]	[kg]	[N/mm ²]
28/09/07	05/12/08	150	150	150	7.68	33.8
28/09/07	05/12/08	150	150	150	7.84	2.58
28/09/07	05/12/08	150	150	150	7.82	3.38
28/09/07	05/12/08	150	150	150	7.64	3.47

Compression resistance tests on samples of concrete for M2 floors					
Packaging	Test	Length	Width	Height	Resistance
date	date	[mm]	[mm]	[mm]	[N/mm ²]
06/09/07	05/12/08	40	40	80	54.0
06/09/07	05/12/08	40	40	80	58.8
06/09/07	05/12/08	40	40	80	58.9
06/09/07	05/12/08	40	40	80	57.3
06/09/07	05/12/08	40	40	80	55.6
06/09/07	05/12/08	40	40	80	57.6
06/09/07	05/12/08	40	40	80	56.0
06/09/07	05/12/08	40	40	80	54.3
06/09/07	05/12/08	40	40	80	57.6
06/09/07	05/12/08	40	40	80	54.6
06/09/07	05/12/08	40	40	80	60.1
06/09/07	05/12/08	40	40	80	59.4
07/09/07	05/12/08	40	40	80	46.4
07/09/07	05/12/08	40	40	80	49.0
07/09/07	05/12/08	40	40	80	45.9
07/09/07	05/12/08	40	40	80	49.2
07/09/07	05/12/08	40	40	80	49.0
07/09/07	05/12/08	40	40	80	46.8

Compression resistance tests on samples of concrete for M2 floors					
Packaging	Test	Length	Width	Height	Resistance
date	date	[mm]	[mm]	[mm]	[N/mm²]
10/09/07	05/12/08	40	40	80	57.5
10/09/07	05/12/08	40	40	80	59.0
10/09/07	05/12/08	40	40	80	54.3
10/09/07	05/12/08	40	40	80	53.1
10/09/07	05/12/08	40	40	80	55.6
10/09/07	05/12/08	40	40	80	54.6
10/09/07	05/12/08	40	40	80	42.9
10/09/07	05/12/08	40	40	80	46.3
10/09/07	05/12/08	40	40	80	44.3
10/09/07	05/12/08	40	40	80	47.5
10/09/07	05/12/08	40	40	80	49.5
10/09/07	05/12/08	40	40	80	52.6

6. Results of the tests

The tests were performed at the Materials and Structures Testing Laboratories of the Università degli Studi di Pavia, No. 1 Via Ferrata (Pavia), in the presence of Eng. Omero Bassotti of Emmedue and also in the presence of Mr. Oddo Boni, who was engaged by Emmedue to record video of the testing itself.

The purpose of the testing was to characterize the behavior of floors of different span and of different polystyrene density.

In order to achieve this, static tests were developed to test the strength of floors which were manufactured directly by the consignee at the Eucentre sample production area: these were subjected to concentrated loads, by means of a hydraulic jack, in order to produce both flexion and shearing zones, with the central zone being subjected to flexion alone (Figure 7)



Figure 7: Static scheme and resulting stresses

The floors were supported upon suitable supports by means of steel cylindrical constraints. The loads were applied with tapered elements so that they would be evenly spread along the short side of the floors themselves. In this configuration, a state of plane deformation was realized and, therefore, double curvatures were avoided (Figure 8).



Figure 8: Static scheme (plan)

The tests were conducted by applying a load to every type of floor which reproduced the bending moment due to an evenly distributed load resulting from a permanent overload of 200 kg/m² and from an accidental overload of 200 kg/m² for the first sample and a 300 kg/m² overload for the second sample. A constant load was subsequently applied and the intensity was increased until the sample was broken.

Below are listed, for each test, the force displacement diagrams of the vertical potentiometers for the two distinct phases of testing.

Test Name	Floor dimensions	Polystyrene thickness	Polystyrene density
Floor 1	2.25m x 4.00m	8 cm	15 kg/m ³
Floor 2	2.25m x 4.00m	8 cm	15 kg/m ³
Floor 3	2.25m x 4.00m	8 cm	25 kg/m ³
Floor 4	2.25m x 4.00m	8 cm	25 kg/m ³
Floor 5	2.25m x 5.00m	16 cm	15 kg/m ³
Floor 5	2.25m x 5.00m	16 cm	15 kg/m ³
Floor 5	2.25m x 5.00m	16 cm	25 kg/m ³
Floor 5	2.25m x 5.00m	16 cm	25 kg/m ³

5.1 Floor 1

Test performed on December 6th 2007.



FORCE_DISPLACEMENT PHASE 1

FORCE_DISPLACEMENT PHASE 2



5.2 Floor 2

Test performed on December 13th 2007.



FORCE_DISPLACEMENT PHASE 1

FORCE_DISPLACEMENT PHASE 2



5.3 Floor 3

Test performed on December 19th 2007.



FORCE_DISPLACEMENT PHASE 1

FORCE_DISPLACEMENT PHASE 2



5.4 Floor 4

Test performed on January 7th 2008.



FORCE_DISPLACEMENT PHASE 1





5.5 Floor 5

Test performed on January 10th 2008.



FORCE_DISPLACEMENT PHASE 1





5.6 Floor 6

Test performed on January 25th 2008.



FORCE_DISPLACEMENT PHASE 1

FORCE_DISPLACEMENT PHASE 2



5.7 Floor 7

Test performed on January 16th 2008.



FORCE_DISPLACEMENT PHASE 1

FORCE_DISPLACEMENT PHASE 2



5.8 Floor 8

Test performed on January 21st 2008.



FORCE_DISPLACEMENT PHASE 1





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 "data", which contains all of the data acquired during the test, as well as a sub-folder called "photos", which contains the various images relative to the test in question. The CD also contains files in Excel format containing the elaborated data.

A DVD which contains the video recordings performed by our personnel during the testing is also enclosed.

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