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EXPERT OPINION

on the applicability of the construction technology "GRÈMOUND non-tectonic system" on grounds of the documentation submitted

Name of Client: Poem Holding Kft.
Address: 6729 Szeged, Óbébai utca 18.
Client's administrator: László FARKAS
Date of assignment: 17 December 2013

This Expert Opinion contains 9 pages and 1 annex
Budapest,
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1 BACKGROUND

Poem Holding Kft. assigned ÉMI Non-profit Ltd. to provide a **preliminary opinion** on the construction technology called "GRÈMOUND non-tectonic system" that functions on the basis of the principle of numbed concrete.

The hollow gypsum formwork elements belonging to the technology are not yet available, so no direct tests can be carried out for the time being. The Client has obtained the evaluation documents of a similar construction system to support the preparation of our expert opinion. Therefore, the results of the earlier examinations carried out by ÉMI Non-profit Ltd. can be used lawfully, taking, of course, the actual differences into account.

According to the information provided by Poem Holding Kft, the construction system would be used in a desert environment for single-floor detached buildings.

It is not the purpose of this Expert Opinion to ensure compliance with the systems of requirements of various countries. Our expert opinion deals with the satisfiability of the material requirements relating to buildings and with the performance characteristics belonging to the material requirements. In the course of our examination, we apply the relevant national and European standards.

2 DATA

2.1 Name of Client: Poem Holding Kft.

2.2 Date of assignment: 17 December 2013

2.3 Documents provided:

- Contract on the use of the test results serving as basis for National Technical Approval (ÉME) No. A-158/1987;
- National Technical Approval (ÉME) No. A-158/1987 and Applicability Examination Protocol;
- Application-specific description for the installation of permanent formworks that can be used for the construction of reinforced concrete structures made by the so-called numbed placement procedure;

- Technical regulation for the design and construction of reinforced concrete structures made by the numbed placement method.

2.4 Brief description of the construction technology "GRÈMOUND non-tectonic system"

The essence of this technology is as follows: manufacture of reinforced concrete wall/floor structures that are usually of complex (ribbed) form and consist of thin elements, using the numbed placement method and applying water-absorbing permanent formworks.

Each of the double-sided gypsum formwork elements that can be used for walls are 598 mm wide, 900 mm high and 85 mm thick, and has one series of hollows. The finished wall structure is 200 mm thick with a double-sided gypsum formwork element and a 30 mm reinforced concrete core.

Each of the one-sided floor formwork elements area needs a floor space of 598x598 mm, is 165 mm thick, and has one row of hollows. The ready floor structure has a constructional height of 200 mm, including a concrete topping of 35 mm.

The density of the material of the gypsum elements is ~ 1,000 kg/m³.

Cross section of the base element of the wall formwork

[drawing]

Cross section of the element the floor formwork

[drawing]

The position and appropriate concrete cover of the reinforcing bars is provided by auxiliary positioning and/or supporting structures and spacers connected to them.

In the module-coordinated construction system, the joining of the wall structures at the corners can be implemented by prefab corner elements.

See the sketch of the planned design of the structures in the figures of Annex 1.

2.5 Brief description of the gypsum concrete structure according to National Technical Approval (ÉME) No. A-158/1987

The gypsum concrete structure serving for the construction of the load-bearing wall and floor structures is a monolith reinforced concrete shell structure with a small (2.5 to 3.0 cm) thickness, prepared in a permanent formwork made with gypsum binding material. The gypsum formwork absorbs the excess water from the concrete, compacts the concrete thereby, and then, during the hardening process, it bleeds water, which replaces the curing of the concrete.

The 599x599 mm large, 10 to 12 mm thick gypsum formwork elements can be manufactured on the spot or can be prefabricated in a plant, with two outer layers for vertical structures and with one outer layer for horizontal or biased structures. The formwork elements are equipped with special plastic spacers through which the reinforcing bars of the reinforced concrete structure are threaded.

The concrete used for pouring must be of at least strength class C 20/25 (MSZ 4798-1:2004); the maximum grain size of the aggregate is 4 mm. The maximum diameter of the reinforcing bars is 8 mm; in the practice, it is usually between 3 and 5 mm.

3 ANALYSIS OF THE AVAILABLE DATA; OBSERVATIONS

3.1 Mechanical strength and stability

Based on the documents submitted and the analysis of the results of earlier examinations, the strength characteristics of the **wall structure** of this construction system are not worse than those of the system examined earlier and, moreover, some extra load-bearing capacity can be expected. This is due to the fact that the deterioration of the wall structure of the system according to National Technical Approval (ÉME) No. A-158/1987 was caused by

the buckling of the free ribs, which, however, cannot be expected in case of the construction technology "GRÈMOUND non-tectonic system".

The dimensioning of the wall structure can be performed on the basis of the relevant EUROCODE. The quality of Concrete Class C 12 can be taken into account for the calculations. The wall structure is not in compliance with the design requirements relating to EUROCODE reinforced concrete structures.

The clear height of the wall structure does not exceed 3.0 m.

Based on the documents submitted and the analysis of the results of earlier examinations, the strength characteristics of the **floor structure** of the construction system are not worse than those of the system examined earlier.

The dimensioning of the floor structure can be performed on the basis of the relevant EUROCODE. *Instead of* Concrete Class C20/25 used previously, Concrete Class C 12/15 has to be taken into account for the calculations. The floor structure is not in compliance with the design requirements relating to EUROCODE reinforced concrete structures.

For the calculation of given structures, the actual loads corresponding to the local conditions (e.g. dust load between attic walls) must also be taken into account.

The earthquake-resistance of the construction system can be verified either by direct tests or by calculations.

Due to the installation of building engineering lines, the reinforced concrete ribs of the load-bearing structure must not be chiselled.

3.2 Fire safety

In the case of the construction technology "GRÈMOUND non-tectonic system", all components of the **wall structure** are to be classified into Fire Class **A1** according to the standard MSZ EN 13501-1.

Taking the fire class of the components into account and evaluating it in accordance with the National Fire Safety Regulation issued by Decree 28/2011. (IX.6.) BM of the Minister of the Interior, the fire class of the wall structure is **A1**.

The design of the cross section of the wall structure is slightly different from that of the vertical-rib wall structure of type c) and of code SÁTFc of the system according to A-158/1987 with a fire resistance limit of REI 30, where there are 200 mm deep blade pillars with a spacing of ≤ 60 cm, starting from the edge of the wall structure in the direction of the service space, and horizontal connection ribs can be found at the bottom and at the top; the height of the structure is 3,000 mm. Examining the fire resistance characteristics, the following observations can be made:

- the wall structure has a symmetrical design; the reinforced concrete slab parallel to the wall face is in the middle of the structure;
- the cross sectional dimensions of the ribs are not smaller;
- the ribs are supported by gypsum formwork elements with spare hollows;
- at a common place, the reinforced concrete ribs have a gypsum cover of ~ 15 mm instead of 10 mm; the lateral protection of the ribs is ensured by the gypsum formwork elements.

Based on the evaluation of the above points, the fire resistance performance of the load-bearing wall structure is expected to reach the value of **REI 30** according to the standard MSZ EN 13501-2.

In the case of the construction technology "GRÈMOUND non-tectonic system", all components of the **floor structure** are to be classified into Fire Class **A1** according to the standard MSZ EN 13501-1.

Taking the fire class of the components into account and evaluating it in accordance with

the National Fire Safety Regulation issued by Decree 28/2011. (IX.6.) BM of the Minister of the Interior, the fire protection class of the floor structure is **A1**.

The cross sectional design of the wall structure is different from that of the ribbed T-beam floor structure of type g) and of code BFFg of the system according to A-158/1987 with a fire resistance limit of REI 30. Examining the fire resistance characteristics, the following observations can be made:

- a slab-and-T-beam load-bearing structure is made again;
- the cross sectional dimensions of the ribs are nearly the same; the spacing of the ribs is identical (60 cm);
- the ribs are supported by gypsum formwork elements with spare hollows;
- at a common place, the reinforced concrete ribs have a gypsum cover of ~ 15 mm instead of 10 mm; the lateral protection of the ribs is ensured by the gypsum formwork elements.

Based on the evaluation of the above points, the fire resistance performance of the load-bearing floor structure is expected to reach the value of **REI 30** according to the standard MSZ EN 13501-2.

In the case of a fire resistance specification, the reveal surfaces of the openings of the wall structures also have to be provided with appropriate fireproof covering.

The construction system "GRÈMOUND non-tectonic system" is expected to be able to satisfy the national fire safety requirements relating to single-floor residential buildings.

In the case of row house development, the individual independent functional units (apartments, housing units) – fire sections – have to be separated by fire walls of high fire-resistance performance (A1 REI-M 120) and, if necessary, their installation method have to be verified by ÉMI Non-profit Ltd in advance.

3.3 Hygiene, health and environment protection

Vapour permeability

Basic characteristic	Performance	Evaluation method
vapour diffusion resistance coefficient of reinforced concrete, μ	by dry method: 130 by wet method: 80	MSZ EN 12524:2000 data taken from the table
vapour diffusion resistance coefficient of gypsum, μ	by dry method: 10 by wet method: 4	MSZ EN 12524:2000 data taken from the table

Hazardous materials

The manufacturer shall make a declaration regarding the hazardous materials used in the products if such hazardous materials are to be considered hazardous according to the "General Checklist" of ER 3 and are listed in the "Indicative List of Hazardous Substances".

It is expected that there will be no need for the use of any hazardous material.

3.4 Safe use and accessibility

Basic characteristic	Performance	Evaluation method
Shock resistance	NPD	Expert evaluation, taking ETAG 009 6.4.1. into account
Resistance to concrete pressure	Appropriate	Expert evaluation, taking the National Technical Approval (ÉME) No. 158/1987 into account
Safety against personal injury	NPD	Expert evaluation, taking ETAG 009 6.4.3. into account

3.5 Noise control

The wall and floor structures of the "GRÈMOUND non-tectonic system" can be considered to be basic structures in respect of soundproofing, and their actual performance depends on the additional layers applied.

In respect of acoustics, the wall and floor structures of the "GRÈMOUND non-tectonic system" differ from the structure included in National Technical Approval (ÉME) No.

A-158/1987 inasmuch as the earlier results cannot be used for judging these structures. Due to the low mass per area unit and the acoustics characteristics of the materials used, the GRÈMOUND wall structure cannot be expected to be used as a partition wall structure of residences.

Basic characteristic	Performance	Evaluation method
Wall structure Weighted attenuation of airborne sound	NPD	MSZ EN ISO 140-7:2001 MSZ EN ISO 717-2:2001
Floor Weighted attenuation of airborne sound	NPD	

3.6 Energy saving and heat control

In respect of heat insulation, the **wall structures** of the "GRÈMOUND non-tectonic system" is characterised by a heat bridge design. The value of the average heat transmission factor can be improved and the heat bridge characteristic can be eliminated by using calibrated heat insulation on the external side. This can be recommended from conservation point of view as well.

In respect of heat insulation, the **floor structures** of the "GRÈMOUND non-tectonic system" is characterised by a heat bridge design. The value of the average heat transmission factor can be improved and the heat bridge characteristic can be eliminated by using calibrated heat insulation on the external side. This can be recommended from conservation point of view as well.

The fulfilment of the requirements relating to conservation, thermal comfort and vapour technology shall be controlled in the course of designing the buildings.

In the case of a demand for heat insulation, the edges of the openings of the frontal wall structures shall be equipped with heat insulation.

Basic characteristic	Performance	Evaluation method
Average heat transmission coefficient of the wall structure , U_{wall} (without heat insulation and calculating with 60 cm rib spacing and 0.34 W/mK thermal conductivity for gypsum)	1.6 W/m ² K	Verification according to the standard MSZ EN ISO 6946:2008
Average heat transmission coefficient of the floor structure , U_{floor} (without heat insulation and calculating with 60 cm rib spacing and 0.34 W/mK thermal conductivity for gypsum)	2.4 W/m ² K	Verification according to the standard MSZ EN ISO 6946:2008
Thermal conductivity of reinforced concrete	2.3 W/mK	MSZ EN 12524:2000 data taken from table
Thermal conductivity of gypsum - for a density of 1000 kg/m ³	0.34 W/mK	MSZ EN 12524:2000 interpolation of data taken from table

3.7 Sustainable use of natural resources

Basic characteristic	Performance	Evaluation method
Durability against physical effects (if appropriate protection against rainwater and sanitary water is provided)	appropriate	in consideration of ETAG 009 6.7.1.1
Durability against chemical effects	appropriate	in consideration of ETAG 009 6.7.1.2
Durability against biological effects	appropriate	in consideration of ETAG 009 6.7.1.3
Resistance to damages occurring during normal use (in case of internal and external surface finishing)	NPD	in consideration of ETAG 009 6.7.2

In the case of any installation other than the environmental classes X0 and X1, the value of concrete coverage shall be calculated according to the specifications of the standard and the proper protection of the structure shall be ensured.

4 EVALUATION SUMMARY

Based on the preliminary evaluation of the performance characteristics detailed in Section 3 and the documents submitted, the construction technology "GRÈMOUND non-tectonic system" **can be suitable** for the intended use, i.e. for the construction of load-bearing wall and floor structures of single-floor residential buildings.

In the case of using the construction technology "GRÈMOUND non-tectonic system", we consider it necessary to adjust the system to local construction materials (aggregates, cement) and real construction circumstances (temperature, humidity, opportunities for mechanisation, local labour force, etc.) and to finalise the technology and the control system in such a manner.

In the case the product types of the structures manufactured by the construction technology "GRÈMOUND non-tectonic system" are defined, the supporting tests shall be carried out by accredited laboratories, taking the design that can be considered as final into account, for the purpose of establishing the performance characteristics that relate to the product and are necessary for satisfying the fundamental requirements.

The system serving for the evaluation and control of the stability of performance: **System (2+)** on grounds of Commission Regulation (EC) No 99/94, in accordance with Annex V to Regulation (EU) No 305/2011 of the European Parliament and of the Council.

5 ANNEX

Annex 1: Detail drawings of GRÈMOUND technology (3 pages)

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ANNEX 1

Grèmound technology

Section, 1:50

Connection of potential shading units

Plan view part, 1:50

Plan view part, 1:10

Place of door/window
Permanent wall formwork 60/90

1:10

Place of door/window

Front view

Side view

Plan view

Numbered reinforced concrete

Permanent gypsum formwork

Place of door/window

GRÈMOUND technology

Permanent floor formwork

1:10

Front view

Side view

Plan view

Section part 1:10

Numbered reinforced concrete

Permanent gypsum formwork

Numbered reinforced concrete

Permanent gypsum formwork

Place of door/window

GRÈMOUND technology



REVISED TECHNICAL TRANSLATION

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