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EXTERNAL THERMAL INSULATION OF BUILDINGS WITH EXPANDED POLYSTYRENE

BY

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Abstract. External thermal insulation of the dwelling walls increasingly interests in the past years due to the tendency to lower the energy consumption both at global and national levels. In Romania it is known that most of the houses built before '90s showed and continue to show a low level of thermal insulation due to the use of materials characterized by increased heat losses and scarce thermal calculation available at that time. These heat losses exert a direct impact and general energy consumption both at national and global level and, not lastly, the owners of these dwelling through the increase of the maintenance invoices. All these aspects lead to the need to thermally insulate these buildings as well as of the new buildings to decrease the energy consumption.

Key words: insulation; fire; façade inspection; polystyrene.

1. Introduction

The external thermal insulation of the dwelling walls based on the system "External Thermal Insulation Composite Systems" (ETICS) could be executed by using as insulating layer (SC 007 - 2010; SR EN 13163 : 2009; SR EN 13499 : 2004):

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a) rigid boards made of fireproofed expanded polystyrene (min. 80… 100 kN/m^2 compressive strength, vertical tensile strength on the faces higher than 100 kN/m^2;

b) front wall boards made of mineral wool with a vertical tensile strength on the faces higher than 100 kN/m^2;

c) extruded polystyrene with a vertical tensile strength on the faces higher than 100 kN/m^2, compressive strength higher than 100 kN/m^2, that may only be used in the foundation and ground contact areas.

Except the three thermal insulation practices listed above, the most frequently used in Romania is the insulation based on an insulating layer made of expended polystyrene (EPS) boards due to the polystyrene's low cost and to the reduced period of time needed to finish the works.

External thermal insulation of the building walls based on an insulating layer of EPS includes benefits and drawbacks.

Among the system benefits the following could be listed:

a) reduction of the heat losses and, respectively, of the energy consumptions;

b) low weight of the polystyrene boards against other materials, which does not essentially change the construction's weight following rehabilitation;

c) it is easy to handle and process;

d) the possibility to rebuild the building front walls, to keep the architectural details, to hide various flaws of the front walls;

e) low cost of the EPS;

f) short period of works execution.

Among the drawbacks of EPS the following could be listed:

a) the absence of clear regulations regarding the implementation of this insulating system;

b) low strength to fire, phenomena which is neglected in our country;

c) low strength to mechanical shocks;

d) aggravation of the after earthquake building inspection to identify the damages occurred (these damages being masked by the relevant insulation);

e) inappropriate execution of this insulation could lead to the occurrence of the mildew in time, between the resistance wall and the EPS and to the detachment of the thermal insulating system from the resistance structure, etc.

2. External Thermal Insulation with Expanded Polystyrene

External insulation of the building walls with EPS (Fig. 1 – http://www.baumitinsulation.co.uk/how-it-works) started to be implemented in our country in 1999, at present being in progress a program of thermal building rehabilitation at national level that applies to the constructions built between 1950 and 1990 (Multiannual national program regarding the increase of the

energy performance of the dwelling buildings), a program applied since 2005. This program includes 50% subsidy of the total cost of the works granted by the state budget, 30% subsidy granted by the local budgets and 20% of the total cost is borne by the dwelling owners.

The biggest issue that the external wall insulation with EPS used in Romania is the insufficiency and/or inexistence of clear norms concerning the execution of this type of insulation. At present, for the heat engineering calculation for buildings is used norm C107/2005 (norm regarding the heat engineering calculation of the construction elements of the buildings). In order to implement the insulation system ETICS with EPS, ASRO (Romanian Standardization Authority) adopted all European standards: SR EN 13499 (adopted in 2004 corresponding to EN 13499 from 2003), standards for definition of the ETICS properties , *i.e*. SR EN 13494... SR EN 13498 from 2005.

Besides these norms, the implementation norms'guides of this system were also drafted. However, these guides never sufficiently made known in media and were never imposed as mandatory to those executing such works (SC 007 – 2010; http://www.qetics.ro).

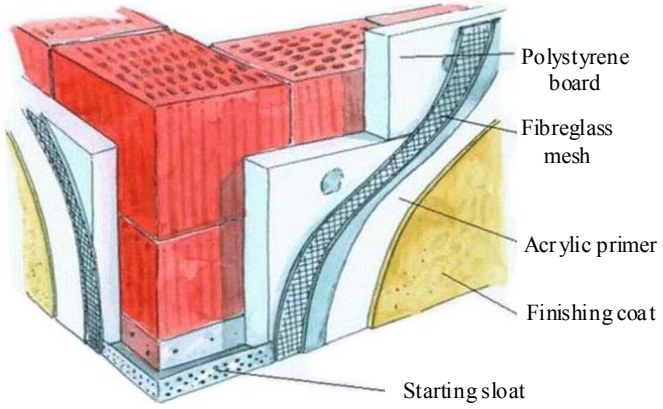

Fig. 1 – Representation of external insulation with expanded polystyrene (EPS).

That these norms set-up the test/measurement practices in accordance with other European codes. However, some are presently just as drafts. It results that these norms cannot be fully implemented. For this reason, the thermal insulation based on EPS is many times realized viciously and this means that

a) the insulation is performed in absence of a thermal rehabilitation project approved by the relevant authorities;

b) the insulation is executed without restoring the support layer in case this is deteriorated, applying over it the mortar layer as binding material or fastening dowels;

c) selection of insufficient thicknesses of the expanded polystyrene, the reason being the reduction of the insulation cost;

d) execution of insulation works with improper materials (polystyrene, dowels, mortar, low quality reinforcement mesh – anonymous manufacturers);

e) insufficient fastening of the polystyrene to the resistance wall (insufficient mortar thicknesses, insufficient number of anchoring dowels);

f) execution of partial buildings insulation, per flat, per level, which causes discontinuities both on horizontal side and cross-wise of the insulation system (Fig. 2 – http://www.skyscrapercity.com);

Fig. 2 – Execution of a partial insulation with EPS of buildings or improper execution (Constanța – Romania).

g) the works are executed by operator teams that have never been trained in this field;

h) the use of non-fireproofed expanded polystyrene as insulating material;

i) selection of improper colours (shrill) for external finishing works;

j) execution of this type of insulation also on high buildings (higher than ground floor + 4 floors) which makes it difficult for the fireman to take action in case of fire;

k) to stop fire spreading on the front walls of the buildings to the window gaps, mineral wool insulation section must be provided, that has better behaviour in case of fire;

l) absence of a final acception of the insulation system by a qualified authority;

m) lack of any good execution warranty for the work's behaviour in time.

All these irregularities will have unforeseeable consequences in the future such as: mildew occurrence between the polystyrene layer and the resistance wall, partial or total detachments of the insulation system from the resistance

Fig. 3 – Partial or total detachments of the thermal insulating system from the resistance structure.

a *b*

Fig. 4 – Fatal fires in buildings insulated with EPS: *a* – Dijon, France (14 Nov. 2010) – 7 people died; *b* – Berlin, Germany, (25th April 2005) – 2 people died.

walls of the structure (Fig. 3 – http://www.qetics.ro), occurrence and uncontrolled fire spread (Fig. 4 – Brandfolkenes Organisation, Danemark, 2010), event that could cause losses of human beings, aggravation of the after-earthquake inspection of the building for identification of the produced damages (these damages being hidden by the relevant insulation) and, of course, loss of the initial investment.

3. Conclusions

The thermal insulation of the external walls of the constructions, based on the expanded polystyrene as insulating material, is efficient if executed by specialized teams of workers and if there is a thermal rehabilitation projects that uses materials with verified characteristics.

Romania needs urgently a program of verification of any and all buildings thermally insulated with this system that reveals the quality of the works execution, its impact in the future and the actions needed to be taken for correction.

It should be limited the use of this insulation system on buildings higher than the ground floor + 4 floors, the reason being the difficult intervention of the firemen in case of fire-risk of intoxication with gases resulted from the polystyrene burning (loss of human beings), and this should be clearly specified in the regulations, inclusively the type of expanded polystyrene that could be used; for nowadays there is a chaos, "everybody insulates in one's own sense".

It is necessary to impose the compulsoriness of existence of a rehabilitation project and the clear steps of verification of these types of insulation, and to follow-up how these behave in time, and to set-up the compulsoriness of execution of these types of works by specialized teams of workers.

REFERENCES

Helmut K., Hartwig M. K., Klaus S., *Long-Term Performance of External Thermal Insulation Systems (ETICS)*. Architectura, **5**, *1*, 11-24 (2006), Instytut Techniki Budowlanej, Poland.

Hideki Y., Hsin-Chieh Y., Masamichi T., Masashi Y., Takafumi N., Manabu K.,, Koji K.,Yasuji Oz., *Study of Test Method for Evaluation of Fire Propagation along Façade Wall with Exterior Thermal Insulation*. Fire Sci. a. Technol., **30**, *1*, 27 - 44, Japan Sci. a. Technol.y Inform. Aggregator, www.jstage.jst.go.jp.

** *Baumit EPS External Thermal Insulation Composite System*. www.baumitinsulation.co.uk/how-it-works.

** Constanța Metro Area. Commie Blocks Rehabilitation, pp. 3 & 19, www.skyscrapercity.com/showthread.php?t=1040237.

*** *Deadly Fires Fuelled by Plastic Insulation - how Many More People and Fire Fighters Must Die?*. Brandfolkenes Organisation, Danemark, 2010, www.brandfolkene.dk .

*** *Ghid pentru aplicarea sistemelor de termoizolaţie "ETICS"*. România, http://www.qetics.ro .

*** *Guideline for European Technical Approval of External Thermal Insulation Composite Systems with Rendering*. Europ. Org. for Techn. Approvals, Brussels, ETAG 004 : 2008.

*** *Produse termoizolante pentru clădiri. Produse fabricate din polistiren expandat (EPS). Specificaţie*. SR EN 13163 : 2009.

*** *Produse termoizolante pentru clădiri. Sisteme compozite de izolare termică la exterior (ETICS) pe bază de polistiren expandat*. SR EN 13499 : 2004.

*** *Soluţii cadru pentru reabilitarea termo-higro-energetică a anvelopei clădirilor de locuit existente.* Contract nr. *429*/8.12.2009, (UAUIM - CCPEC nr. *21*/8.12.2009), Ministerul Dezvoltării Regionale şi Turismului – MDRT, SC 007 - 2010.

*** *The European Association for External Thermal Insulation Composite Systems*. Germany, www.ea-etics.eu .

IZOLAREA TERMICĂ EXTERIOARĂ A CLĂDIRILOR CU POLISTIREN EXPANDAT

(Rezumat)

Izolarea termică exterioară a pereţilor clădirilor de locuit prezintă un interes din ce în ce mai mare în ultimii ani datorită tendinţei de reducere a consumului energetic la nivel global cât şi la nivel naţional. În Romania este ştiut faptul că majoritatea locuinţelor construite înainte de anii 1990 prezentau şi prezintă în continuare un grad scăzut de izolare termică datorită utilizării unor materiale caracterizate prin pierderi mari de căldură şi a calculului termic deficitar existent la acea vreme. Aceste pierderi de căldură se reflectă direct asupra consumului general de energie la nivel naţional cât şi la nivel global şi nu în ultimul rând asupra proprietarilor acestor locuinţe, prin creşterea facturilor la întreţinere. Toate aceste aspecte conduc la necesitatea izolării termice a acestor clădiri cât şi a clădirilor noi în vederea reducereii consumului de energie.