CLASSIFICATION OF FIRE RESISTANCE
FIRES-CR-015-18-AUPE Edition 2

Load-bearing wall composed of EcoCocon straw modules

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CLASSIFICATION OF FIRE RESISTANCE IN ACCORDANCE WITH EN 13501-2: 2016

with direct field of application

FIRES-CR-015-18-AUPE Edition 2

Name of the product: Load-bearing wall composed of EcoCocon straw modules

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1. INTRODUCTION

This classification report defines the resistance to fire classification which was assigned to a load-bearing wall element composed of EcoCocon straw modules in accordance with the procedures given in EN 13501-2: 2016.

This document is the 2nd edition of classification of fire resistance in accordance with EN 13501-2: 2016 No. FIRES-CR-015-18-AUPE, issued by FIRES, s.r.o., Batizovce on 23. 02. 2018. Within the 2nd edition aspects related to alternative wall coverings – as stated in clause 2.2 of this report were added. Constructional changes were added to the classification on the basis of test reports [3] - [8] as per clause 3.1 of this document. This edition of the document supersedes all previous editions of the classification report.

2. DETAILS OF CLASSIFIED PRODUCT

2.1 GENERAL

The element of the report, a load-bearing wall composed of EcoCocon straw modules, is defined as a load-bearing wall with fire separating function.

2.2 PRODUCT DESCRIPTION

The product is a load-bearing wall composed of EcoCocon straw modules.

Dimensions of individual modules	(2900 x 1000 x 250) mm (height x width x thickness) (2900 x 1200 x 250) mm (height x width x thickness) (2900 x 800 x 250) mm (height x width x thickness)

Construction of wall
The wall is assembled of EcoCocon straw modules.

Construction of the module
Each module has a double front frame construction made of timber spruce profiles measuring 45 x 95 mm. Modules 1000 mm x 1200 mm wide include two additional vertical profiles placed mid-width of the module. The top and bottom module edges are covered by 12,0 mm thick plywood plate. The individual components of the frame are fixed together at the top and bottom horizontal edge with 8 x 120 mm timber screws (two at each module corner, and one at each mid-width profile) and 4,5 x 50 mm screws (two screws to each frame profile at a distance of 65 mm from module edges and a distance from each other of ≤ 200 mm).

Modules are reinforced by 45 x 45 mm transverse timber spruce profiles placed at both vertical module edges and between vertical reinforcement profiles, at a maximum distance of 1000 mm from the bottom and top module edge. Transverse profiles are fixed to frame profiles with two 8 x 80 mm screws to each profile and to mid-width profiles with 6 x 120 mm screws. Spruce boards 20,0 mm thick x 200 mm wide are fixed between the vertical edges to transverse profiles by two 8 x 80 screws mm to each profile. Boards are located in the thirds of the frame height.

Individual modules are fixed together at the vertical module edges by 8 x 100 mm screws placed at a maximum spacing of 470 mm. Two additional timber C24 profiles 100 x 100 mm are placed on the top wall edge to ensure balanced loading of wall.

The core of the wall consist of pressed straw with a nominal bulk density of 100 kg.m^{-3}.

Covering of the face of the wall

Variant A:
The face of the external wall is covered with an airtight membrane - type Tyvek Solid (manufacturer: DuPont) - fixed to timber profiles with 8 x 45/90 mm plywood strips with 20 mm long steel staples. Steico Protect H (producer: Steico) wood fibre boards with dimensions 535 x 1300 x 60 mm and a bulk density of 265 kg.m^{-3}

are fixed to the timber construction with steel staples 90,0 mm long, spaced very 150 mm. The wood fibre boards are joined together by tongue-groove joints at the edges.

The internal face of the wall is covered with clay base plaster applied to two layers of total thickness 20 – 25 mm with a reinforced glass fibre mesh (producer: Vertex). An additional fine clay plaster approx. 5,0 mm thick is added as a finish. Clay plaster is applied directly upon the straw surface and timber studs.

Variant B:
The face of the external wall is covered by an airtight membrane, type Tyvek Solid (manufacturer: DuPont) - fixed to timber profiles by 6 mm thick x 80 mm wide plywood strips and 63 mm long steel staples spaced every 150 mm.

The face of internal wall is without any surface treatment (bare wall panels).

Variant C:
The face of the external wall is covered by an airtight membrane, type FireStop A2 (manufacturer: Fassawall), fixed to timber profiles with 6 mm thick x 80 mm wide plywood strips and wood screws 4,0 x 40 mm spaced every 200 mm.

The face of the internal wall is covered by horizontally oriented gypsum boards, type Knauf KGBi (H2) (manufacturer: Knauf), with dimensions 3000 x 1200 x 12,5 mm fixed to timber profiles with screws TN 3,5 x 50 mm spaced every 200 mm. Boards joints are covered with Knauf glass-laminated tape and Knauf Uniflott filler. Two layers 4,8 mm thick x 80 mm wide with wood fibre underlayment strips (manufacturer: Steico) are placed between gypsum boards and timber profiles. The strips are fixed to timber profiles with 14 mm long steel staples.

Variant D:
The face of the external wall is covered by an airtight membrane, type Tyvek Solid (manufacturer: DuPont), fixed to timber profiles with 6 mm thick x 80 mm wide plywood strips and 63 mm long steel staples spaced every 150 mm.

The face of the internal wall is covered with horizontally oriented gypsum boards, type Knauf KGBi (H2) (manufacturer: Knauf), with dimensions 3000 x 1200 x 12,5 mm fixed to timber profiles with TN 3,5 x 50 mm screws spaced every 200 mm. Board joints are covered by Knauf glass-laminated tape and Knauf Uniflott filler. Two layers of 4,8 mm thick x 80 mm wide wood fibre underlayment strips (manufacturer: Steico) are placed between gypsum boards and timber profiles. Strips are fixed to timber profiles with 14 mm long steel staples.

Variant E:
The face of the external wall is covered by an airtight membrane, type Tyvek Solid (manufacturer: DuPont), fixed to timber profiles with 6 mm thick and 80 mm wide plywood strips and 63 mm long steel staples spaced every 150 mm.

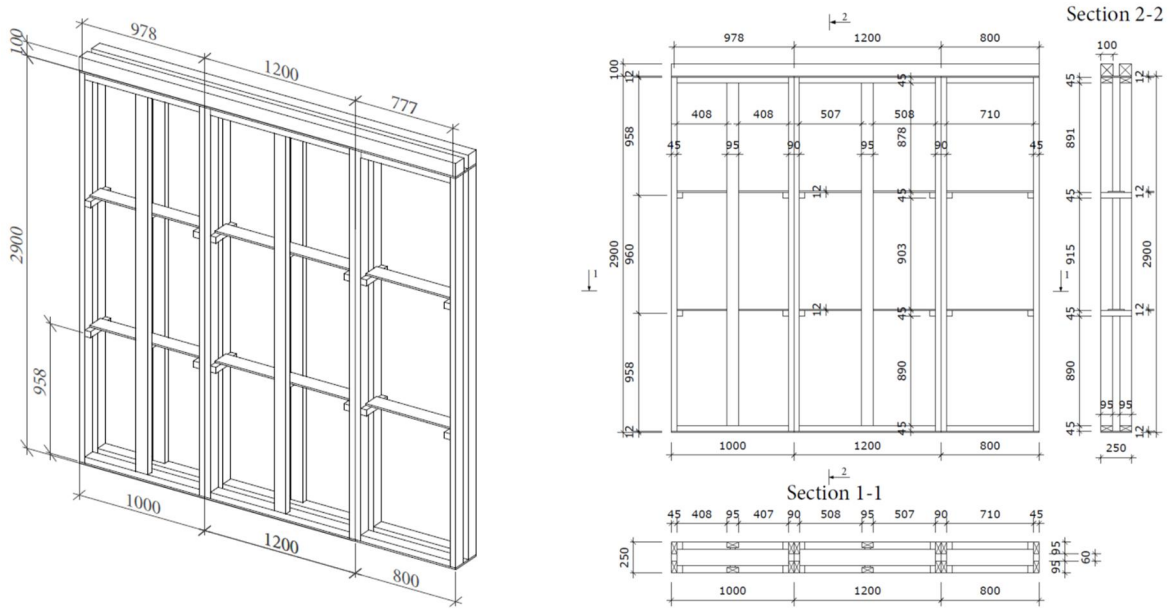
The face of the internal wall is covered by horizontally oriented gypsum fibre boards (manufacturer: Fermacell) with dimensions 2500 x 1250 x 12,5 mm fixed to timber profiles with TN 3,5 x 50 mm screws spaced every 150 mm. Two layers of 4,8 mm thick x 80 mm wide wood fibre underlayment strips (manufacturer: Steico) are placed between gypsum boards and timber profiles. Strips are fixed to timber profiles with 14 mm long steel staples.

Variant F:
The face of the external wall is covered by an airtight membrane, type Tyvek Solid (manufacturer: DuPont), fixed to timber profiles by 6 mm thick x 80 mm wide plywood strips and 63 mm long steel staples spaced each 150 mm.

The face of the internal wall is covered by gypsum plaster, type MP75 (manufacturer: Knauf), in two layers with a total thickness of 25 mm. Underlayment strips of 4,8 mm thick x 80 mm wide wood fibre (manufacturer: Steico) are stapled to timber profiles under the gypsum plaster with 14 mm long steel staples.

Variant G:
The face of the external wall is covered by an airtight membrane, type Tyvek Solid (manufacturer: DuPont), fixed to timber profiles by 6 mm thick x 80 mm wide plywood strips and 63 mm long steel staples spaced every 150 mm. Straw boards - type VestaEco PROTECT (manufacturer: VestaEco COMPOSITES Sp. z o.o.) - with 1200 x 800 x 60 mm dimensions and a bulk density of 180 kg.m^{-3} are fixed to the timber frame construction with steel staples 25 x 100 mm, spaced every 70 mm at the perimeter of the wall and every 150 mm at the wall surface to the vertical timber profiles of modules. Boards are joined together with tongue-groove joints at the board edges.

The face of the internal wall is covered by horizontally oriented gypsum boards, type Knauf KGBi (H2) (manufacturer: Knauf), with dimensions 3000 x 1200 x 12,5 mm, fixed to timber profiles with TN 3,5 x 50 mm screws spaced every 200 mm. Board joints are covered with Knauf glass-laminated tape and Knauf Uniflott filler. Two layers of 4,8 mm thick x 80 mm wide wood fibre underlayment strips (manufacturer: Steico) are placed between gypsum boards and timber profiles. Strips are fixed to timber profiles with 14 mm long steel staples.



More detailed information about product construction is shown in drawings in appropriate test reports [1 - 8].

3. TEST REPORTS IN SUPPORT OF CLASSIFICATION

3.1 TEST REPORTS

No.	Name of laboratory	Name of sponsor	Test report No.	Date of the test	Test method
[1]	FIRES, s.r.o., Batizovce, SR	UAB EcoCocon, Vilnius, Lithuania	FIRES-FR-021-18-AUNE	29. 01. 2018	EN 1365-1: 2012 / AC: 2013
[2]			FIRES-FR-022-18-AUNE	30. 01. 2018	
[3]			FIRES-FR-017-21-AUNE	03. 02. 2021	
[4]			FIRES-FR-018-21-AUNE	04. 02. 2021	
[5]			FIRES-FR-019-21-AUNE	04. 02. 2021	
[6]			FIRES-FR-051-21-AUNE	15. 03. 2021	
[7]			FIRES-FR-052-21-AUNE	16. 03. 2021	
[8]			FIRES-FR-111-21-AUNE	19. 05. 2021	

[1 – 8] Test specimens were conditioned according to EN 1363-1 before the fire resistance test

3.2 TEST RESULTS

No./ Test method	Parameter		Results
[1] EN 1365-1: 2012/AC: 2013 Variant A	surface treatment (interior / exterior)		clay base plaster / boards Steico Protect H
	applied load		axial load 70,0 kN/m
	temperature curve		standard temperature/time curve
	load-bearing capacity		121 minutes no failure
	integrity	cotton pad	121 minutes no failure
		gap gauges	121 minutes no failure
		sustained flaming	121 minutes no failure
	thermal insulation	average temperature (140 K)	121 minutes no failure
		maximal temperature (180 K)	121 minutes no failure
	radiation		121 minutes no failure
	mechanical action		-
	specimen orientation		Internal face of wall (clay plaster) exposed to fire
[2] EN 1365-1: 2012/AC: 2013 Variant A	surface treatment (interior / exterior)		clay base plaster / boards Steico Protect H
	applied load		axial load 70,0 kN/m
	temperature curve		**external fire exposure curve**
	load-bearing capacity		121 minutes no failure
	integrity	cotton pad	121 minutes no failure
		gap gauges	121 minutes no failure
		sustained flaming	121 minutes no failure
	thermal insulation	average temperature (140 K)	121 minutes no failure
		maximal temperature (180 K)	121 minutes no failure
	radiation		121 minutes no failure
	mechanical action		-
	specimen orientation		External face of wall (boards Steico Protect H) exposed to fire
[3] EN 1365-1: 2012/AC: 2013 Variant B	surface treatment (interior / exterior)		bare panel / membrane Tyvek Solid
	applied load		axial load 70,0 kN/m
	temperature curve		standard temperature/time curve
	load-bearing capacity		39 minutes no failure
	integrity	cotton pad	39 minutes
		gap gauges	39 minutes no failure
		sustained flaming	39 minutes
	thermal insulation	average temperature (140 K)	39 minutes
		maximal temperature (180 K)	39 minutes
	radiation		39 minutes no failure
	mechanical action		-
	specimen orientation		Internal face of wall (bare panel) exposed to fire

No./ Test method	Parameter		Results
[4] EN 1365-1: 2012/AC: 2013 Variant C	surface treatment (interior / exterior)		gypsum boards Knauf KGBi (H2) / membrane FireStop A2
	applied load		axial load 70,0 kN/m
	temperature curve		**external fire exposure curve**
	load-bearing capacity		90 minutes no failure
	integrity	cotton pad	90 minutes no failure
		gap gauges	90 minutes no failure
		sustained flaming	90 minutes no failure
	thermal insulation	average temperature (140 K)	90 minutes no failure
		maximal temperature (180 K)	90 minutes no failure
	radiation		90 minutes no failure
	mechanical action		-
	specimen orientation		External face of wall (membrane FireStop A2) exposed to fire
[5] EN 1365-1: 2012/AC: 2013 Variant D	surface treatment (interior / exterior)		gypsum boards Knauf KGBi (H2) / membrane Tyvek Solid
	applied load		axial load 70,0 kN/m
	temperature curve		standard temperature/time curve
	load-bearing capacity		55 minutes no failure
	integrity	cotton pad	55 minutes
		gap gauges	55 minutes no failure
		sustained flaming	55 minutes
	thermal insulation	average temperature (140 K)	55 minutes
		maximal temperature (180 K)	55 minutes
	radiation		55 minutes no failure
	mechanical action		-
	specimen orientation		Internal face of wall (gypsum boards) exposed to fire
[6] EN 1365-1: 2012/AC: 2013 Variant E	surface treatment (interior / exterior)		boards Fermacell / membrane Tyvek Solid
	applied load		axial load 70,0 kN/m
	temperature curve		standard temperature/time curve
	load-bearing capacity		58 minutes no failure
	integrity	cotton pad	58 minutes
		gap gauges	58 minutes no failure
		sustained flaming	58 minutes
	thermal insulation	average temperature (140 K)	58 minutes
		maximal temperature (180 K)	58 minutes
	radiation		58 minutes no failure
	mechanical action		-
	specimen orientation		Internal face of wall (boards Fermacell) exposed to fire

No./ Test method	Parameter		Results
[7] EN 1365-1: 2012/AC: 2013 Variant F	surface treatment (interior / exterior)		gypsum plaster MP75 / membrane Tyvek Solid
	applied load		axial load 70,0 kN/m
	temperature curve		standard temperature/time curve
	load-bearing capacity		107 minutes no failure
	integrity	cotton pad	107 minutes
		gap gauges	107 minutes no failure
		sustained flaming	107 minutes
	thermal insulation	average temperature (140 K)	107 minutes
		maximal temperature (180 K)	107 minutes
	radiation		107 minutes no failure
	mechanical action		-
	specimen orientation		Internal face of wall (gypsum plaster MP75) exposed to fire
[8] EN 1365-1: 2012/AC: 2013 Variant G	surface treatment (interior / exterior)		gypsum boards type Knauf KGBi (H2) / straw boards VestaECO PROTECT
	applied load		axial load 70,0 kN/m
	temperature curve		**external fire exposure curve**
	load-bearing capacity		91 minutes no failure
	integrity	cotton pad	91 minutes no failure
		gap gauges	91 minutes no failure
		sustained flaming	91 minutes no failure
	thermal insulation	average temperature (140 K)	91 minutes no failure
		maximal temperature (180 K)	91 minutes no failure
	radiation		91 minutes no failure
	mechanical action		-
	specimen orientation		External face of wall (boards VestaECO PROTECT) exposed to fire

The performance criteria of insulation are automatically assumed not to be satisfied when the criterion of integrity ceases to be satisfied (acc. to clause 11.4.2 of EN 1363-1).

Regarding low temperatures on an unexposed specimen surface below 300°C, the performance criteria of radiation is to be complied with to satisfy requirements.

[1], [2] The fire test was terminated in the 122nd minute upon request of test sponsor

[3] The test was discontinued in 41st minute because of the specimen integrity failure

[4] The test was discontinued in 91st minute upon request of test sponsor

[5] The test was discontinued in 56th minute because of the specimen integrity failure

[6] The test was discontinued in 59th minute because of the specimen integrity failure

[7] The test was discontinued in 108th minute because of the specimen integrity failure

[8] The test was discontinued in 92nd minute upon request of test sponsor

4. CLASSIFICATION AND FIELD OF APPLICATION

4.1 REFERENCE OF CLASSIFICATION

This classification has been carried out in accordance with clause 7.3.2 of EN 13501-2: 2016.

4.2 CLASSIFICATION

The element, **a load-bearing wall composed of EcoCocon straw modules covered on its external face with Steico Protect H wood fibre boards and on its internal face with clay base plaster (Variant A)**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification: **(Valid for fire action on internal wall face covered with clay base plaster)** **RE 120 / REI 120 / REW 120**
Fire resistance classification: **(Valid for fire action on external wall face covered with wood fibre boards Steico Protect H)** **RE 120-ef / REI 120-ef / REW 120-ef**

The element, **a load-bearing wall composed of EcoCocon straw modules covered on its external face with a Tyvek Solid airtight membrane and without surface treatment (Variant B) on its internal face**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification: **(Valid for fire action on internal wall face without surface treatment)** **RE 30 / REI 30 / REW 30**

The element, **a load-bearing wall composed of EcoCocon straw modules covered on its external face with a FireStop A2 membrane and on the internal face with Knauf KGBi (H2) (Variant C) gypsum boards**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification: **(Valid for fire action on external wall face covered with FireStop A2 membrane)** **RE 90-ef / REI 90-ef / REW 90-ef**

The element**, a load-bearing wall composed of EcoCocon straw modules covered on its external face with a Tyvek Solid airtight membrane and on its internal face with Knauf KGBi (H2) (Variant D) gypsum boards**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification:

(Valid for fire action on internal wall face covered with gypsum boards Knauf KGBi (H2))

RE 30 / REI 45 / REW 30

Standard EN 13501-2: 2016, clause 7.3.2 does not define classes RE 45 and REW 45, but the classified product satisfies load-bearing capacity (R), integrity (E) and heat radiation (W) performance criterion for a classification time of 45 minutes.

The element, **a load-bearing wall composed of EcoCocon straw modules covered on its external face with a Tyvek Solid airtight membrane and on its internal face with Fermacell (Variant E) gypsum fibre boards,** is classified according to the following combinations of performance parameters and classes, as appropriate.

Fire resistance classification:

(Valid for fire action on internal wall face covered with gypsum fibre boards Fermacell)

RE 30 / REI 45 / REW 30

Standard EN 13501-2: 2016, clause 7.3.2 does not define classes RE 45 and REW 45, but the classified product satisfies load-bearing capacity (R), integrity (E) and heat radiation (W) performance criterion for a classification time of 45 minutes.

The element, **a load-bearing wall composed of EcoCocon straw modules covered on its external face with a Tyvek Solid airtight membrane and on its internal face with Knauf MP75 (Variant F) gypsum plaster**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification:

(Valid for fire action on internal wall face covered with gypsum plaster Knauf MP75)

RE 90 / REI 90 / REW 90

The element, **a load-bearing wall composed of EcoCocon straw modules covered from external face with straw boards VestaEco PROTECT and from internal face with Knauf KGBi (H2) (Variant G) gypsum boards**, is classified according to the following combinations of performance parameters and classes as appropriate:

Fire resistance classification:

(Valid for fire action on external wall face covered with straw boards VestaEco PROTECT)

RE 90-ef / REI 90-ef / REW 90-ef

4.3 FIELD OF APPLICATION

This classification is valid for the following end use applications:

Height	– increase in the height above 3000 mm is not allowed; – decrease in the height is allowed;
Width	– change in the wall width is allowed; – extension in the width of wall is allowed only as a replication of modules as tested; – decrease in the module width is allowed, but not increase; – maximum width of module is 1200 mm;
Thickness of wall and materials	– increase in the thickness of the wall and individual component materials is allowed;
Linear dimensions of boards	– it is allowed to decrease the linear dimensions of boards, but not thickness;
Fixation of materials	– decrease in distance of fixing centres is allowed;
Size and method of loading	– maximum load 70,0 kN/m;
	– decrease in the applied load is allowed;
	– method of loading - axial loading is not allowed to be change for eccentric loading;

5. LIMITATIONS

This classification document does not represent type approval or certification of the product.

The classification is valid provided that the product, field of application and standards and regulations are not changed.

Approved by:

Ing. Štefan Rástocký
Head of the testing laboratory

Prepared by:

Dávid Šubert
Technician of the testing laboratory

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