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Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
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European Technical Assessment

ETA 22/0889 of 16/01/2023

English version prepared by Itecons

General Part

Technical Assessment Body issuing the European Technical Assessment: Itecons - Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade	
Trade name of the construction product	TFS (Timber-Frame System)
Product family to which the construction product belongs	Building kits, Units and Prefabricated Elements Product area code: 34
Manufacturer	Rusticasa – Construções, Lda. Zona Industrial de Campos, Polo 1 4920-909 Vila Nova de Cerveira Portugal
Manufacturing plant	Zona Industrial de Campos, Polo 1 4920-909 Vila Nova de Cerveira Portugal
This European Technical Assessment contains	49 pages including 2 Annexes which forms integral part of this ETA
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 340308-00-0203 - *Timber Building Kits*

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Specific parts

1. Technical description of the product

The TFS (Timber-Frame System), hereinafter referred to as TFS, is a predesigned timber building kit prepared in the factory for each individual building, and delivered as a package to be assembled on site. The kit includes the main building parts such as external walls, internal walls, intermediate floor and roof panels. Further components are described in Annex A. The essential construction details, including their joints, are also described in Annex A. The maximum number of storeys of the kit is three (ground floor + 1st floor + 2nd floor).

The external walls are load-bearing with a timber structure of 105 mm or 145 ± 5 mm thickness. The composition of the external wall panels is as follows:

- External wooden cladding with 20 mm of thickness, made of *Cryptomeria japonica* or *Pinus sylvestris*, mechanically fixed to the battens and counter battens;
- Wooden batten with 32 mm of thickness, made of *Pinus sylvestris* or *Pinus radiata*, mechanically fixed to the studs;
- Wooden counter-batten with 10 mm of thickness, made of *Pinus sylvestris* or *Pinus radiata*, mechanically fixed to the studs (nail – 45 mm, applied with pneumatic nail gun);
- Waterproofing membrane;
- High density fiberboard with a thickness of 3 mm;
- Timber frame structure made of *Cryptomeria japonica or Pinus radiata* or *Pinus sylvestris* or *Picea abies* comprised of wooden studs 45 x 105 mm^2 in case of the timber structure of 105 mm or 45 x 145 ± 5 mm^2 in case of the timber structure of 145 mm. The maximum distance between studs is 590 mm, the timber strength class of the *Cryptomeria japonica* is CYS II according to NP 4544 and the timber strength class of the other timbers species used in the kit is C18 or higher according to EN 14081-1 (EN 338);
- Thermal insulation made of mineral wool or wood fibre, with 100 mm thickness in case of the timber structure of 105 mm or 140 mm thickness in case of the timber structure of 145 mm;
- OSB board with 12 mm of thickness or particleboard with 12 mm of thickness;
- Wooden batten with 25 mm of thickness, made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris*, mechanically fixed to the studs;
- Wooden counter-batten with 25 mm of thickness, made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris*, mechanically fixed to the studs (nail – 90 mm, applied with pneumatic gun);
- Internal finishing made of vertical or horizontal wooden cladding with 20 mm of thickness, made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board with 12.5 mm of thickness mechanically fixed to the battens and counter battens.

The maximum possible dimensions of a prefabricated wall panel, that can be delivered from the factory, are 3,0 m × 10,0 m.

The interior walls, TFS 80, are similar to the external walls, however the section of the wooden studs is 45 x 80 mm^2. The finishing on one side is composed of gypsum board and wooden cladding with 20 mm of thickness. The other side of the panel is composed of a polyethylene sheet and wooden cladding with 20 mm of thickness. The interior of the walls is filled with 50 mm of mineral wool.

The roof panels consist of a wooden frame with rafters of 70 mm or 85 mm or 90 mm wide and of 160 mm or 190 mm or 200 mm or 220 mm high. The thickness of the thermal insulation layer is 160 mm and does not vary. Therefore, the roof panels are composed as follows:

- External roof cladding (e.g., ceramic tiles) installed on construction site;
- Wooden batten with 32 mm of thickness, made of *Pinus sylvestris* (for the installation of the external roof cladding), mechanically fixed to the substrate board (nail – 75 mm, applied on site with pneumatic nail gun);
- Wooden batten with 45 x 45 mm^2 made of *Pinus sylvestris*, mechanically fixed with screws 6 x 120 mm to the substrate board;
- Waterproofing membrane;
- Substrate board made of OSB or particleboard with 12 mm of thickness for pitched roofs and with 18 mm of thickness for flat roofs;
- Timber frame structure made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris* comprised of wooden rafters. The dimensions of the wooden rafters may be as follows:
    - 70 mm x 160 mm;
    - 70 mm x 190 mm;
    - 70 mm x 200 mm;
    - 70 mm x 220 mm;
    - 85 mm x 160 mm;
    - 85 mm x 190 mm;
    - 85 mm x 200 mm;
    - 85 mm x 220 mm;
    - 90 mm x 160 mm;
    - 90 mm x 190 mm;
    - 90 mm x 200 mm;
    - 90 mm x 220 mm.

  The timber strength class of the *Cryptomeria japonica* is CYS II according to NP 4544 and the timber strength class of the other timbers species used is C18 or higher according to EN 14081-1 (EN 338);

- Thermal insulation with 160 mm of thickness made of mineral wool or wood fibre;
- Vapour membrane;
- Wooden batten with 25 mm of thickness made of *Picea abies* or *Pinus radiata* or *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Picea abies* or *Pinus radiata* or *Pinus sylvestris*;
- Interior finishing made of wooden cladding with 20 mm of thickness, made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or made of gypsum board with 12.5 mm of thickness, mechanically fixed to the battens and counter battens.

The maximum possible dimensions of a prefabricated roof panel, that can be delivered from the factory, are 2,5 m × 10,0 m.

When the building has a 1st floor or a 1st and 2nd floor, the slab between floors is formed by CRIPTOLAM F210 panels (0.5 x 8.0 m^2) built in glued laminated solid wood with 210 mm of thickness, assembled side-by-side with nailed joint covers in the upper-face, or, alternatively, the slab between floors is formed by panels (2.5 x 8.0 m^2) composed of linear wooden structural elements made of *Cryptomeria* *japonica* or *Pinu*s radiata or *Pinus sylvestris* or *Picea abies* connected together by a wood-based board (OSB or particleboard 18 mm thickness).

Both types of floor panels are covered by mineral wool (45 mm) and wooden floor and are directly placed on the walls.

The kit is intended to be assembled on a rigid ground slab, for example a concrete slab that is covered by mineral wool and a wooden floor.

The insulation products that may be incorporated in the kit TFS, as described, do not contribute to the loadbearing capacity and stability of the works.

Other accessories complete the TFS kit, such as:

- Columns and beams;
- Anchorages to assemble the TFS components (e.g., the façade panels and interior wall partitions into the concrete slab);
- External joint-covers;
- Exterior roof-boards;
- Roof eaves wood boards;
- Windows and doors.

The kit is manufactured in accordance with the provisions of this European Technical Assessment and as laid down in the technical documentation deposited at the Itecons.

2. Specification of the intended use(s) in accordance with the applicable European Assessment Document (hereinafter EAD)

2.1. Intended use

Timber building kit TFS is intended to be used as a residential building or as a service building. It can be produced as ground floor buildings or can have two additional storey.

The external envelope was evaluated as sufficient watertight under normal climatic conditions.

Concerning the vapour permeability and moisture resistance, the timber frame building kit is intended to be used for buildings with a humidity flow (diffusion) from inside towards outside.

Vapour permeability of the timber building kit was evaluated for specific climatic conditions. The kit should be re-assessed in case of application under different climatic conditions.

The use of the kit in areas where termite attack can occur is extremely inadvisable without additional chemical treatment. These kind of treatments are not part of this assessment.

The provisions made in this European Technical Assessment are based on an assumed working life of the building kit of 50 years for the load-bearing structure and non-accessible components and materials, and 25 years for repairable or replaceable components and materials like claddings, roofing materials, exteriors trims, and integrated components like windows and doors provided, as minimum according to the EAD, provided that the conditions lay down for the installation, packaging, transport and storage as well as appropriate use, maintenance and repair are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a mean for choosing the right product in relation to the expected economically reasonable working life of the works.

3. Performance of the product and references to the methods used for its assessment

The assessment of the TFS kit according to the Basic Work Requirements (BWR) was carried out in compliance with EAD 340308-00-0203. The characteristics of the components shall correspond to the respective values laid down in the technical documentation of this ETA, checked by Itecons.

3.1. Mechanical resistance and stability (BWR 1)

The components of the kit, that are necessary for the mechanical resistance, stiffness and stability, are listed in Annex A and described regarding to their composition and geometry.

If the kit is intended to be used in areas where seismic actions are predictable, the response of the structure should be studied case-by-case, taking into account national regulations, if needed.

The foundations are not part of the kit. The individual loads and conditions of each kit should be taken in account for the structural design of the foundations or design of constructions that the kit will be fitted on.

3.1.1. Resistance, stability and stiffness of wall, floor and roof structures and their connections against vertical and horizontal loads

Indication of geometrical data of the components and elements and their properties related to mechanical resistance and stability are used as an expression of resistance, stability and stiffness of wall, floor and roof elements against vertical and horizontal loads.

The wall, floor and roof elements, including relevant fasteners for their assembling, are presented in Annex A.

Information given are used case by case calculations according to EN 1990, EN 1991, EN 1995-1-1 and EN 1998-1 taking into consideration respective requirements of the Member States regarding ultimate limit state and serviceability limit state.

Additionally, numerical calculations are presented in Annex B for CRIPTOLAM F210.

3.1.2. Shear resistance in plane direction against horizontal loads

The shear resistance and stiffness were determined according to EN 594. The test specimen was composed by a TFS 105 wall panel. The composition of the test specimen was as follows:

- External wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*;
- Wooden batten with 32 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus sylvestris*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs of 45 x 105 mm^2 made of *Cryptomeria japonica*;
- Thermal insulation with 100 mm of thickness made of mineral wool;
- OSB board with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Pinus sylvestris*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*.

The dimensions of the test specimen were 2.4 m x 2.4 m without openings. The test specimen was fixed to the test rig by clamps. The test was carried out with a vertical load of 5 kN. The mean value of racking stiffness obtained was 1798 N/mm and the mean value racking strength was 21.08 kN.

No performance assessed regarding the shear resistance and stiffness of the following TFS 105 and TFS 145 solutions:

- External wooden cladding with 20 mm of thickness made of *Pinus sylvestris*;
- Wooden batten with 32 mm of thickness made of *Pinus radiata*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus radiata*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 105 mm^2 made of *Pinus radiata* or *Pinus sylvestris* or *Picea abies* or timber frame structure comprised of wooden studs 45 x 145 mm^2 made of *Cryptomeria japonica or Pinus radiata* or *Pinus sylvestris* or *Picea abies*;
- Thermal insulation with 100 mm of thickness made of wood fibre or with 140 mm of thickness made of mineral wool or wood fibre;
- Particleboard 12 mm;
- Wooden batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Wooden counter-batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Picea abies* or *Pinus sylvestris* or vertical wooden cladding with 20 mm of thickness made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board 12.5 mm.

3.1.3. Compression resistance – log walls

Not relevant.

3.1.4. Settling of construction – log walls

Not relevant.

3.1.5. Corrosion protection of metal fasteners

The corrosion protection of metal fasteners of the TFS kit are presented in Table 1.

Table 1: Corrosion protection of metal fasteners

Corrosion protection of metal fasteners	
Screws and threaded rods	Corrosion protection in service class 1 and 2 acc. ETA 11/0030
Clip connectors	Corrosion protection in service class 1, 2 and 3 acc. ETA 10/0189

3.2. Safety in case of fire (BWR 2)

3.2.1. Reaction to fire

No performance assessed.

3.2.2. Resistance to fire

No performance assessed.

3.2.3. External fire performance of roofs

No performance assessed.

3.3. Hygiene, health and the environment (BWR 3)

3.3.1. Water vapour resistance

Vapour permeability and moisture resistance of the external envelope was assessed based on calculations according to EN ISO 13788. The calculations showed that the building envelope is adequate for the intended use in case of humidity flow (diffusion) from inside towards outside, taking into account an internal humidity class of 2 according to EN ISO 13788 for the climate assessed.

If the kit is used under different conditions, a separate assessment needs to be carried out in accordance with EN ISO 13788 using the material properties listed in Annex A as part of the design of works.

3.3.2. Watertightness

3.3.2.1. External envelope

The watertightness of the facade was assessed according to EN 12865, procedure A. The test specimen was composed by a TFS 105 wall panel with dimensions of 1200 x 2400 mm^2. The composition of the test specimen was as follows:

- External wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*;
- Wooden batten with 32 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus sylvestris*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 105 mm^2 made of *Cryptomeria japonica*;
- Thermal insulation with 100 mm of thickness made of mineral wool;
- OSB board with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Pinus sylvestris*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*.

The results are presented in Table 2.

Table 2: Watertightness according EN 12865

Test procedure		**Procedure A**
Water total flow		**7.2 l/min**
Pressure difference [Pa]	Duration [min]	Test specimen condition
0	20	Entirely waterproof
0 to 150	10	Entirely waterproof
0 to 300	10	Entirely waterproof
0 to 450	10	Entirely waterproof
0 to 600	10	Entirely waterproof
0 to 750	10	Entirely waterproof
0 to 900	10	Entirely waterproof

Test procedure		Procedure A
Water total flow		7.2 l/min
0 to 1050	10	Entirely waterproof
0 to 1200	10	Entirely waterproof

No performance assessed regarding the watertightness of the following TFS 105 and TFS 145 solutions:

- External wooden cladding with 20 mm of thickness made of *Pinus sylvestris*;
- Wooden batten with 32 mm of thickness made of *Pinus radiata*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus radiata*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 105 mm^2 made of *Pinus radiata* or *Pinus sylvestris* or *Picea abies* or timber frame structure comprised of wooden studs 45 x 145 mm^2 made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris* or *Picea abies*;
- Thermal insulation with 100 mm of thickness made of wood fibre or thermal insulation with 140 mm of thickness made of mineral wool or wood fibre;
- Particleboard with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Wooden counter-batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Picea abies* or *Pinus sylvestris* or vertical wooden cladding with 20 mm of thickness made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board 12.5 mm.

Watertightness of the roof panels: No performance assessed.

3.3.2.2. Internal surfaces

Internal surfaces in wet areas are not part of the kit.

3.3.3. Durability class/use class

The TFS kit is designed in compliance with durability requirements according the intended working life of 50 years for the load-bearing structure and non-accessible components and materials, and 25 years for repairable or replaceable components and materials like claddings, roofing materials, exteriors trims, and integrated components like windows and doors provided.

The adequacy of the hazard classes/use classes according to EN 335 for wood and wood-based products used in the kit is presented in the Table 3.

Table 3: Hazard class/use class according to EN 335

Type of component	Hazard classes/Use classes
External components	2, 3
Internal components	1

The natural durability according EN 350 is presented in Table 4.

Table 4: Natural durability according EN 350

Species	Fungi	Hylotrupes	Anobium	Termites
Cryptomeria japonica	5	D	n/a	S
Picea abies	4	S	S	S
Pinus radiata	4-5	D	S	S
Pinus sylvestris	3-4	D	D	S

The use of the kit in regions where termite attack may occur is impermissible without additional chemical treatment. The chemical treatment shall be done according to local regulations for such use. This European Technical Assessment does not involve methods of chemical treatment of the kit.

Additional measures of the works shall be taken to provide adequate durability if the kit will be used in climate condition with often incidence of driving rain and snow.

The assumed intended working life requires regular maintenance as specified by the manufacturer instructions.

The adequacy of the service classes according to EN 1995-1-1 for the fasteners used in the kit is given in Annex A.

3.3.4. Content, emission and/or release of dangerous substances

No performance assessed.

3.4. Safety and accessibility in use (BWR 4)

3.4.1. Impact resistance

The mechanical resistance against impact loads (hard and soft body impact) was assessed according the indications of the section 2.2.13 of the EAD 340308-00-0203.

Two types of TFS wall panels were tested. One test specimen was concerning TFS 105 and the other concerning TFS 145. The composition of the test specimens was as follows:

- External wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*;
- Wooden batten with 32 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus sylvestris*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 105 mm^2 or 45 x 145 mm^2 made of *Cryptomeria japonica*;
- Thermal insulation with 100 mm of thickness made of mineral wool for TFS 105 or thermal insulation with 140 mm thickness made of wood fibre for TFS 145;
- OSB board with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Pinus sylvestris*;
- Internal finishing composed of wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*.

The dimensions of the test specimens were 1250 x 3900 mm^2 and the distance (maximum distance) between studs was 550 mm and 560 mm, for TFS 105 and TFS 145, respectively.

The results are presented in the Table 5 and Table 6.

Table 5: Impact resistance – TFS 105

Impact point	Impact energy			
	Serviceability impact resistance		Safety in use impact resistance	
	6 J (H1)	400 J (S1)	10 J (H2)	900 J (S1)
1	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass
H1 – Hard body impactor with mass of 514 ± 19 g H2 – Hard body impactor with mass of 1030 ± 40 g S1 – Soft body impactor with mass of 50 ± 0.5 kg				
Pass	No penetration and no deterioration, only small impact marks were observed			
Pass	No penetration and no deterioration			
Pass	No collapse, no penetration and no projection			
Pass	No collapse, no penetration and no projection, although a panel rupture in the wood cladding was observed			

Table 6: Impact resistance – TFS 145

Impact point	Impact energy			
	Serviceability impact resistance		Safety in use impact resistance	
	6 J (H1)	400 J (S1)	10 J (H2)	900 J (S1)
1	Pass	Pass	Pass	Pass
2	Pass	Pass	Pass	Pass
H1 – Hard body impactor with mass of 514 ± 19 g H2 – Hard body impactor with mass of 1030 ± 40 g S1 – Soft body impactor with mass of 50 ± 0.5 kg				
Pass	No penetration and no deterioration, only small impact marks were observed			
Pass	No penetration and no deterioration			
Pass	No collapse, no penetration and no projection			
Pass	No collapse, no penetration and no projection, although a panel rupture in the wood cladding was observed			

No performance assessed regarding the impact resistance of the following TFS 105 and TFS 145 solutions:

- External wooden cladding with 20 mm of thickness made of *Pinus sylvestris*;
- Wooden batten with 32 mm thickness made of *Pinus radiata*;
- Wooden counter-batten with 10 mm thickness made of *Pinus radiata*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 100 mm^2 or 45 x 145 mm^2 made of *Pinus radiata or Pinus sylvestris* or *Picea abies* or timber frame structure comprised of wooden studs 45 x 145 mm^2 made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris* or *Picea abies*;
- Thermal insulation 100 mm made of wood fibre or 140 mm thickness made of mineral wool;
- Particleboard with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;

- Wooden counter-batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Picea abies* or *Pinus sylvestris* or vertical wooden cladding with 20 mm of thickness made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board 12.5 mm.

Impact resistance of the internal walls, roof panels and floor panels: No performance assessed.

3.5. Protection against noise (BWR 5)

3.5.1. Airborne sound insulation of walls, floors and roof structures

The acoustical performance was carried out in accordance with EN ISO 10140-1, EN ISO 10140-2, 3 and EN ISO 10140-4 and EN ISO 717-1 and EN ISO 717-2.

The airborne sound insulation of a TFS 105 wall panel with the following composition was tested:

- External wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*;
- Wooden batten with 32 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus sylvestris*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 100 mm^2 made of *Cryptomeria japonica*;
- Thermal insulation with 100 mm of thickness made of mineral wool;
- OSB board with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Pinus sylvestris*;
- Internal finishing composed of wooden cladding 20 mm made of *Cryptomeria japonica*.

The test specimen nominal dimensions were 3140 x 3140 mm^2. The perimeter of the test specimen was sealed with mineral wool. The test area had the standardized value of 10 m^2 (3160 x 3160 mm^2).

The CRIPTOLAM F210 floor panels were also tested. The test specimen area was 3540 x 3540 mm^2 and the test area had approximately 10 m^2 (3160 x 3160 mm^2). The perimeter of the test specimen was sealed with mineral wool.

The weighted apparent sound reduction index of the components tested is shown in the Table 7.

Table 7: Weighted apparent sound reduction index

Component	Acoustical performance
TFS 105 panel tested	R_w = 36 dB
CRIPTOLAM F210 with mineral wool (45mm) and wooden floor	R_w = 53 dB

No performance assessed regarding the weighted apparent sound reduction index of the following TFS 105 and TFS 145 solutions:

- External wooden cladding with 20 mm of thickness made of *Pinus sylvestris*;
- Wooden batten with 32 mm of thickness made of *Pinus radiata*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus radiata*;

- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 100 mm^2 made of *Pinus radiata* or *Pinus sylvestris* or *Picea abies* or timber frame structure comprised of wooden studs 45 x 145 mm^2 made of *Cryptomeria japonica or Pinus radiata or Pinus Sylvestris* or *Picea abies*;
- Thermal insulation with 100 mm of thickness made of wood fibre or thermal insulation with 140 mm of thickness made of mineral wool or wood fibre;
- Particleboard with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Wooden counter-batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Picea abies* or *Pinus sylvestris* or vertical wooden cladding with 20 mm of thickness made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board 12.5 mm.

The weighted apparent sound reduction index of the internal walls and roof panels: No performance assessed.

3.5.2. Impact sound insulation of floors

A CRIPTOLAM F210 panel with mineral wool (45 mm) and wooden floor was tested. The specimen tested for the impact sound insulation was the same used in the determination of airborne sound insulation. The result is shown in the Table 8.

Table 8: Impact sound insulation of the CRIPTOLAM F210 panels

Component	Acoustical performance
CRIPTOLAM F210 with mineral wool (45mm) and wooden floor	Weighted apparent sound reduction index $L_{n,w}$ = 59 dB

No performance assessed regarding the weighted apparent sound reduction index of the floor panels composed of linear wooden structural elements made of *Cryptomeria japonica* or *Pinu*s radiata or *Pinus sylvestris* or *Picea abies* connected together by a wood-based board (OSB or particleboard 18 mm thickness).

3.5.3. Sound absorption

No performance assessed.

3.6. Energy economy and heat retention (BWR 6)

3.6.1. Thermal resistance and thermal transmittance

The thermal resistance, R_T, of the TFS 105, TFS 145, roof panels and CRIPTOLAM F210 was determined according to EN ISO 6946 and EN ISO 10211.

The constructive solutions assessed for TFS 105 and TFS 145 panels are presented in Table 9.

Table 9: Solutions assessed of TFS 105 and TFS 145 with mineral wool or wood fibre

Wall solution	External cladding	Wooden batten 32 mm + Counter wooden batten 10 mm	Frame structure 100 mm	Bracing element	Wooden battens 25 mm	Internal finishing
Solution 1	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/Pinus radiata*	*Cryptomeria japonica*
Solution 2			*Cryptomeria japonica*		*Picea abies*	
Solution 3			*Pinus sylvestris/Pinus radiata*		*Pinus sylvestris/Pinus radiata*	
Solution 4			*Pinus sylvestris/Pinus radiata*		*Picea abies*	
Solution 5			*Picea abies*		*Pinus sylvestris/Pinus radiata*	
Solution 6			*Picea abies*		*Picea abies*	
Solution 7	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/Pinus radiata*	*Picea abies*
Solution 8			*Cryptomeria japonica*		*Picea abies*	
Solution 9			*Pinus sylvestris/Pinus radiata*		*Pinus sylvestris/Pinus radiata*	
Solution 10			*Pinus sylvestris/Pinus radiata*		*Picea abies*	
Solution 11			*Picea abies*		*Pinus sylvestris/Pinus radiata*	
Solution 12			*Picea abies*		*Picea abies*	
Solution 13	*Pinus sylvestris*	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/Pinus radiata*	*Cryptomeria japonica*
Solution 14			*Cryptomeria japonica*		*Picea abies*	
Solution 15			*Pinus sylvestris* /Pinus radiata		*Pinus sylvestris/Pinus radiata*	
Solution 16			*Pinus sylvestris* /Pinus radiata		*Picea abies*	
Solution 17			*Picea abies*		*Pinus sylvestris/Pinus radiata*	
Solution 18			*Picea abies*		*Picea abies*	
Solution 19	Pinus sylvestris	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/Pinus radiata*	*Picea abies*
Solution 20			*Cryptomeria japonica*		Piceas Abies	

Wall solution	External cladding	Wooden batten 32 mm + Counter wooden batten 10 mm	Frame structure 100 mm	Bracing element	Wooden battens 25 mm	Internal finishing
Solution 21			*Pinus sylvestris/ Pinus radiata*		*Pinus sylvestris/Pinus radiata*	
Solution 22			*Pinus sylvestris/ Pinus radiata*		*Picea abies*	
Solution 23			*Picea abies*		*Pinus sylvestris/Pinus radiata*	
Solution 24			*Picea abies*		*Picea abies*	
Solution 25	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/ Pinus radiata*	Gypsum board
Solution 26			*Cryptomeria japonica*		*Picea abies*	
Solution 27			*Pinus sylvestris/ Pinus radiata*		*Pinus sylvestris/ Pinus radiata*	
Solution 28			*Pinus sylvestris/ Pinus radiata*		*Picea abies*	
Solution 29			*Picea abies*		*Pinus sylvestris/ Pinus radiata*	
Solution 30			*Picea abies*		*Picea abies*	
Solution 31	Pinus sylvestris/Pinus radiata	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*	OSB or particleboard	*Pinus sylvestris/ Pinus radiata*	Gypsum board
Solution 32			*Cryptomeria japonica*		*Piceas Abies*	
Solution 33			*Pinus sylvestris/ Pinus radiata*		*Pinus sylvestris/ Pinus radiata*	
Solution 34			*Pinus sylvestris/ Pinus radiata*		*Picea abies*	
Solution 35			*Picea abies*		*Pinus sylvestris/ Pinus radiata*	
Solution 36			*Picea abies*		*Picea abies*	

The results of the thermal resistance and of the thermal transmission coefficient of the TFS 105 and TFS 145 panels assessed are presented in the Table 10 and Table 11, respectively.

Table 10: Thermal resistance and thermal transmission coefficient of the TFS 105

Wall solution	MW – 0.034 W/(m.K)		WF – 0.036 W/(m.K)		WF – 0.038 W/(m.K)	
	R_{tot} $(m^2.K)/W$	U $W/(m^2.K)$	R_{tot} $(m^2.K)/W$	U $W/(m^2.K)$	R_{tot} $(m^2.K)/W$	U $W/(m^2.K)$
Solution 1	4.27	0.23	4.13	0.24	4.01	0.25
Solution 2	4.31	0.23	4.17	0.24	4.05	0.25
Solution 3	4.13	0.24	0.25	3.89	0.26	0.25
Solution 4	4.17	0.24	4.05	0.25	3.93	0.25
Solution 5	4.19	0.24	4.06	0.25	3.95	0.25
Solution 6	4.23	0.24	4.10	0.24	3.98	0.25
Solution 7	4.23	0.24	4.09	0.24	3.97	0.25
Solution 8	4.27	0.23	4.13	0.24	4.01	0.25
Solution 9	4.09	0.24	3.97	0.25	3.85	0.26
Solution 10	4.13	0.24	4.01	0.25	3.89	0.26
Solution 11	4.08	0.24	3.95	0.25	3.84	0.26
Solution 12	4.12	0.24	3.99	0.25	3.88	0.26
Solution 13	4.20	0.24	4.06	0.25	3.94	0.25
Solution 14	4.24	0.24	4.10	0.24	3.98	0.25
Solution 15	4.06	0.25	3.94	0.25	3.82	0.26
Solution 16	4.10	0.24	3.98	0.25	3.86	0.26
Solution 17	4.12	0.24	3.99	0.25	3.88	0.26
Solution 18	4.16	0.24	4.03	0.25	3.92	0.26
Solution 19	4.16	0.24	4.02	0.25	3.90	0.26
Solution 20	4.20	0.24	4.06	0.25	3.94	0.25
Solution 21	4.02	0.25	3.90	0.26	3.78	0.26
Solution 22	4.06	0.25	3.94	0.25	3.82.	0.26
Solution 23	4.08	0.24	3.95	0.25	3.84	0.26
Solution 24	4.12	0.24	3.99	0.25	3.88	0.26
Solution 25	4.10	0.24	3.96	0.25	3.84	0.26
Solution 26	4.14	0.24	4.00	0.25	3.88	0.26
Solution 27	3.96	0.25	3.83	0.26	3.72	0.27

Wall solution	MW – 0.034 W/(m.K)		WF – 0.036 W/(m.K)		WF – 0.038 W/(m.K)	
	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)
Solution 28	4.00	0.25	3.88	0.26	3.76	0.27
Solution 29	4.02	0.25	3.89	0.26	3.78	0.26
Solution 30	4.06	0.25	3.93	0.25	3.81	0.26
Solution 31	4.03	0.25	3.89	0.26	3.77	0.27
Solution 32	4.07	0.25	3.93	0.25	3.81	0.26
Solution 33	3.89	0.26	3.77	0.27	3.65	0.27
Solution 34	3.93	0.25	3.81	0.26	3.69	0.27
Solution 35	3.95	0.25	3.82	0.26	3.71	0.27
Solution 36	3.99	0.25	3.86	0.26	3.75	0.27

Table 11: Thermal resistance and thermal transmission coefficient of the TFS 145

Wall solution	MW – Alpharock 225 -0.034 W/(m.K)		WF – Steico flex F036 -0.036 W/(m.K)		WF – Steico flex F038 -0.038 W/(m.K)	
	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)
Solution 1	5.32	0.19	5.14	0.19	4.97	0.20
Solution 2	5.36	0.19	5.18	0.19	5.01	0.20
Solution 3	5.12	0.20	4.95	0.20	4.80	0.21
Solution 4	5.16	0.19	4.99	0.20	4.84	0.21
Solution 5	5.22	0.19	5.04	0.20	4.88	0.20
Solution 6	5.25	0.19	5.08	0.20	4.92	0.20
Solution 7	5.28	0.19	5.10	0.20	4.93	0.20
Solution 8	5.32	0.19	5.12	0.20	4.97	0.20
Solution 9	5.08	0.20	4.91	0.20	4.76	0.21
Solution 10	5.12	0.20	4.95	0.20	4.80	0.21
Solution 11	5.18	0.19	5.00	0.20	4.84	0.21
Solution 12	5.25	0.19	5.07	0.20	4.90	0.20
Solution 13	5.25	0.19	5.07	0.20	4.90	0.20
Solution 14	5.29	0.19	5.11	0.20	4.94	0.20

Wall solution	MW – Alpharock 225 -0.034 W/(m.K)		WF – Steico flex F036 -0.036 W/(m.K)		WF – Steico flex F038 -0.038 W/(m.K)	
	R_{tot} (m^2.K)/W	U W/(m^2.K)	R_{tot} (m^2.K)/W	U W/(m^2.K)	R_{tot} (m^2.K)/W	U W/(m^2.K)
Solution 15	5.05	0.20	4.88	0.20	4.73	0.21
Solution 16	5.09	0.20	4.92	0.20	4.77	0.21
Solution 17	5.15	0.19	4.97	0.20	4.81	0.21
Solution 18	5.19	0.19	5.01	0.20	4.85	0.21
Solution 19	5.21	0.19	5.03	0.20	4.86	0.21
Solution 20	5.25	0.19	5.07	0.20	4.90	0.20
Solution 21	5.01	0.20	4.84	0.21	4.69	0.21
Solution 22	5.05	0.20	4.88	0.20	4.73	0.21
Solution 23	5.10	0.20	4.93	0.20	4.77	0.21
Solution 24	5.15	0.19	4.97	0.20	4.81	0.21
Solution 25	5.15	0.19	4.97	0.20	4.80	0.21
Solution 26	5.19	0.19	5.01	0.20	4.84	0.21
Solution 27	4.95	0.20	4.78	0.21	4.62	0.22
Solution 28	4.99	0.20	4.82	0.21	4.67	0.21
Solution 29	5.04	0.20	4.87	0.21	4.71	0.21
Solution 30	5.08	0.20	4.91	0.20	4.75	0.21
Solution 31	5.08	0.20	4.90	0.20	4.73	0.21
Solution 32	5.12	0.20	4.94	0.20	4.77	0.21
Solution 33	4.88	0.21	4.71	0.21	4.56	0.22
Solution 34	4.92	0.20	4.75	0.21	4.60	0.22
Solution 35	4.97	0.20	4.80	0.21	4.64	0.22
Solution 36	5.01	0.20	4.84	0.21	4.68	0.21

No performance assessed regarding the thermal resistance and the thermal transmission coefficient of the TFS 105 and TFS 145 solutions with Internal finishing composed of wooden cladding with 20 mm of thickness made of *Pinus sylvestris*.

The thermal resistance and the thermal transmission coefficient of the roof panels were determined for the solutions presented in Table 12.

Table 12: Solutions assessed of the roof panels

Roof solution	Bracing element 12 mm (Exterior)	Thermal insulation 160 mm	Wooden rafters 70 mm/90 mm x 160 mm/190mm/200mm	Wooden battens 25 mm	Internal finishing (Interior)
Solution 1	OSB or particleboard	Mineral wool 0,04 W/(m.K)	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	*Cryptomeria japonica*
Solution 2			*Pinus sylvestris/ Pinus radiata*	*Pinus sylvestris/ Pinus radiata*	
Solution 3			*Cryptomeria japonica*	*Picea abies*	
Solution 4			*Pinus sylvestris/ Pinus radiata*	*Picea abies*	
Solution 5	OSB or particleboard	Mineral wool 0,04 W/(m.K)	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	*Picea abies*
Solution 6			*Pinus sylvestris/ Pinus radiata*	*Pinus sylvestris/ Pinus radiata*	
Solution 7			*Cryptomeria japonica*	*Picea abies*	
Solution 8			*Pinus sylvestris/ Pinus radiata*	*Picea abies*	
Solution 9	OSB or particleboard	Mineral wool 0,04 W/(m.K)	*Cryptomeria japonica*	*Pinus sylvestris/ Pinus radiata*	Gypsum board
Solution 10			*Pinus sylvestris/ Pinus radiata*	*Pinus sylvestris/ Pinus radiata*	
Solution 11			*Cryptomeria japonica*	*Picea abies*	
Solution 12			*Pinus sylvestris/ Pinus radiata*	*Picea abies*	

The results of thermal resistance and of thermal transmission coefficient of the roof panels are presented in the Table 13.

Table 13: Thermal resistance and thermal transmission coefficient of the roof panels

Roof solution	Thermal insulation 160 mm		Thermal insulation 160 mm + air cavity 30 mm		Thermal insulation 160 mm + air cavity 40 mm	
	Wooden studs 70 mm					
	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)
Solution 1	4.27	0.23	4.79	0.21	4.81	0.21
Solution 2	4.01	0.25	4.51	0.22	4.52	0.22
Solution 3	4.31	0.23	4.83	0.21	4.85	0.21
Solution 4	4.05	0.25	4.55	0.22	4.57	0.22
Solution 5	4.23	0.24	4.75	0.21	4.77	0.21
Solution 6	3.97	0.25	4.47	0.22	4.48	0.22

Roof solution	Thermal insulation 160 mm		Thermal insulation 160 mm + air cavity 30 mm		Thermal insulation 160 mm + air cavity 40 mm	
	Wooden studs 70 mm					
	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)
Solution 7	4.27	0.23	4.79	0.21	4.81	0.21
Solution 8	4.01	0.25	4.51	0.22	4.53	0.22
Solution 9	4.41	0.23	4.62	0.22	4.64	0.22
Solution 10	4.13	0.24	4.34	0.23	4.35	0.23
Solution 11	4.44	0.23	4.66	0.21	4.68	0.21
Solution 12	4.17	0.24	4.38	0.23	4.39	0.23
Roof solution	Thermal insulations 160 mm		Thermal insulation 160 mm + air cavity 30 mm		Thermal insulation 160 mm + air cavity 40 mm	
	Wooden studs 90 mm					
	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)	R_{tot} (m².K)/W	U W/(m².K)
Solution 1	4.48	0.22	4.71	0.21	4.73	0.21
Solution 2	4.17	0.24	4.38	0.23	4.40	0.23
Solution 3	4.52	0.22	4.75	0.21	4.77	0.21
Solution 4	4.21	0.24	4.43	0.23	4.45	0.22
Solution 5	4.44	0.23	4.67	0.21	4.69	0.21
Solution 6	4.13	0.24	4.34	0.23	4.36	0.23
Solution 7	4.48	0.22	4.71	0.21	4.73	0.21
Solution 8	4.17	0.24	4.39	0.23	4.41	0.23
Solution 9	4.31	0.23	4.54	0.22	4.56	0.22
Solution 10	3.99	0.25	4.21	0.24	4.23	0.24
Solution 11	4.35	0.23	4.58	0.22	4.60	0.22
Solution 12	4.04	0.25	4.25	0.24	4.27	0.23

No performance assessed regarding the thermal resistance and the thermal transmission coefficient of the roof panels with the following components:

- Wooden rafters with the following dimensions:
  - 70 mm x 220 mm;
  - 85 mm x 160 mm;
  - 85 mm x 190 mm;
  - 85 mm x 200 mm;
  - 85 mm x 220 mm;
  - 90 mm x 220 mm.

- Thermal insulation with 160 mm of thickness made of Wood fibre;
- Internal finishing composed of wooden cladding with 20 mm of thickness made of *Pinus sylvestris*.

The results of thermal resistance and of thermal transmission coefficient of the CRIPTOLAM F210 covered with mineral wool (45 mm) and wooden floor are as follows:

- Ascendent flow: R_{tot} = 4.15 m^2.K/W; U = 0.24 W/m^2.K;
- Descendent flow: R_{tot} = 4.32 m^2.K/W; U = 0.23 W/m^2.K.

No performance assessed regarding the thermal resistance and the thermal transmission coefficient of the floor panels composed of linear wooden structural elements made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris* or *Picea abeas* connected together by a wood-based board (OSB or particleboard 18 mm thickness).

3.6.2. Air permeability

The air permeability of the facade was assessed according to EN 12114. The test specimen was composed by a TFS 105 wall panel with dimensions of 1200 x 2400 mm^2. The composition of the test specimen was as follows:

- External wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*;
- Wooden batten with 32 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus sylvestris*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 100 mm^2 made of *Cryptomeria japonica*;
- Thermal insulation with 100 mm of thickness made of mineral wool;
- OSB board with 12 mm of thickness;
- Wooden batten with 25 mm of thickness made of *Pinus sylvestris*;
- Wooden counter-batten with 25 mm of thickness made of *Pinus sylvestris*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Cryptomeria japonica*.

The results are presented in Table 14.

Table 14: Air permeability of the tested TFS 105 panel according EN 12114

Pressure P (Pa)	Air flow V_x (m^3/h)	Air flow at normal conditions V_0 (m^3/h)	Air permeability in relation with overall area V_A (m^3/hm^2)	Air permeability in relation with length of joint V_L (m^3/hm)
50	1.26	1.25	0.43	0.17
100	1.88	1.86	0.65	0.26
150	2.20	2.18	0.76	0.30
200	2.45	2.43	0.84	0.34
250	2.88	2.86	0.99	0.40
300	3.07	3.04	1.1	0.42

Pressure P (Pa)	Air flow V_x (m^3/h)	Air flow at normal conditions V_0 (m^3/h)	Air permeability in relation with overall area V_A (m^3/hm^2)	Air permeability in relation with length of joint V_L (m^3/hm)
450	3.64	3.61	1.3	0.50
600	4.23	4.19	1.5	0.58

No performance assessed regarding the air permeability of the following TFS 105 and TFS 145 solutions:

- External wooden cladding with 20 mm of thickness made of *Pinus sylvestris*;
- Wooden batten with 32 mm of thickness made of *Pinus radiata*;
- Wooden counter-batten with 10 mm of thickness made of *Pinus radiata*;
- Waterproofing membrane;
- High density fiberboard with 3 mm of thickness;
- Timber frame structure comprised of wooden studs 45 x 100 mm^2 made of *Pinus radiata* or *Pinus sylvestris* or *Picea abies* or timber frame structure comprised of wooden studs 45 x 145 mm^2 made of *Cryptomeria japonica* or *Pinus radiata* or *Pinus sylvestris* or *Picea abies*;
- Thermal insulation with 100 mm of thickness made of wood fibre or thermal insulation with 140 mm of thickness made of mineral wool or wood fibre;
- Particleboard 12 mm;
- Wooden batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Wooden counter-batten with 25 mm of thickness made of *Cryptomeria japonica* or *Pinus radiata*;
- Internal finishing composed of horizontal wooden cladding with 20 mm of thickness made of *Picea abies* or *Pinus sylvestris* or vertical wooden cladding with 20 mm of thickness made of *Cryptomeria japonica* or *Picea abies* or *Pinus sylvestris* or gypsum board 12.5 mm.

Air permeability of the roof panels: No performance assessed.

3.6.3. Thermal Inertia

Specific heat capacities and material densities are listed in Annex A. These values were obtained from EN ISO 10456:2007 and declarations of performance of the kit components.

4. Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

According to the Decision 1999/455/EU of European Commission the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) applicable is 1.

5. Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

The ETA is issued on the basis of agreed data/information, deposited at Itecons, which identifies the product that has been assessed and judged. It is the manufacturer’s responsibility to make sure that all those who use the kit are appropriately informed of specific conditions laid down in this ETA.

Changes to the kit or the components or their production process should be notified to the Itecons before the changes are introduced. Itecons will decide whether or not such changes affect the ETA and if so whether further assessment or alterations to the ETA shall be necessary.

Issued in Coimbra on 16.01.2023

By

Technical Assessment Unit of

Itecons – Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade

Andreia Gil
Senior Official

(*Technical Assessment Unit Coordinator*)

Validated document

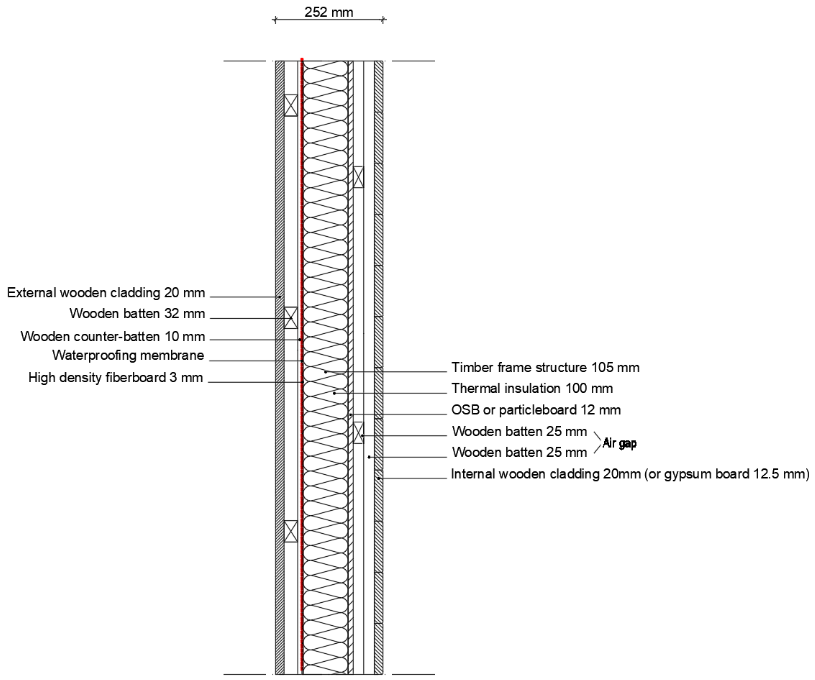
(Administration)

ANNEX A – Index of building elements

The list of relevant drawings of the kit build-up and construction details
External walls
1. TFS 105 – interior horizontal wood cladding
2. TFS 145 – interior horizontal wood cladding
3. TFS 105 – interior vertical wood cladding
4. TFS 145 – interior vertical wood cladding
Internal Walls
5. TFS 80 – horizontal wood cladding
6. TFS 80 – vertical wood cladding
Roof
7. Roof panel with hidden rafters
8. Roof panel with visible rafters
Floor
9. CRIPTOLAM F210
10. Floor panels composed of linear wooden structural elements
Connection between kit elements
11. TFS 105 – ground floor
12. TFS 145 – ground floor
13. TFS 80 – ground floor
14. TFS 105 – Floor panels composed of linear wood strucutre
15. TFS 145 – Floor panels composed of linear wood strucutre
16. TFS 105 – interior wall
17. TFS 145 – interior wall
18. Interior wall – interior wall
19. TFS 105 – window (transversal cross section)
20. TFS 145 – window (transversal cross section)
21. TFS 105 – window (longitudinal cross section)
22. TFS 145 – window (longitudinal cross section)
23. TFS 105 – sill
24. TFS 145 – sill
25. Exterior corner TFS 105
26. Exterior corner TFS 145
27. Interior corner TFS 80
28. TFS 105 longitudinal joint
29. TFS 145 longitudinal joint

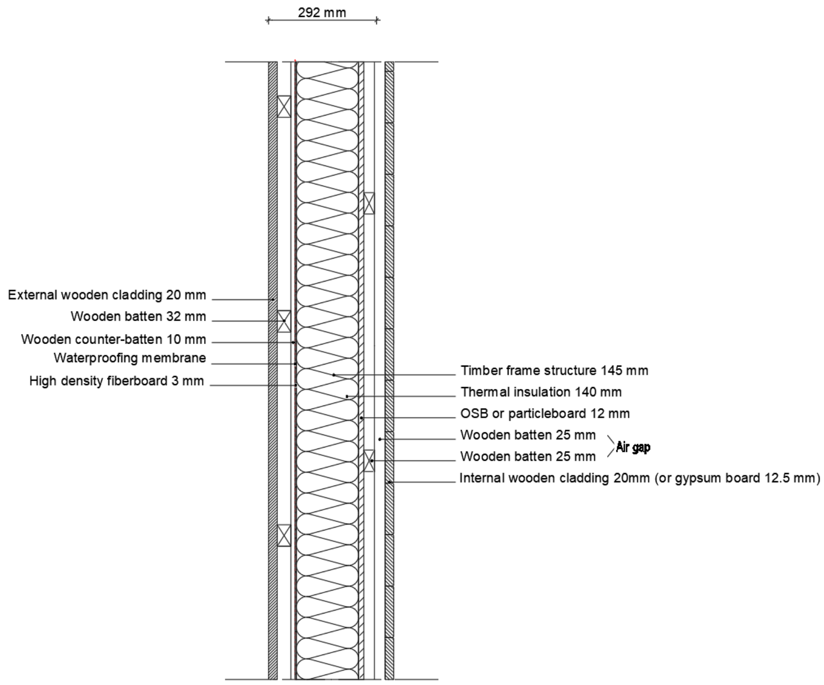
1 – TFS 105 – Interior horizontal wood cladding

Wall cross section:



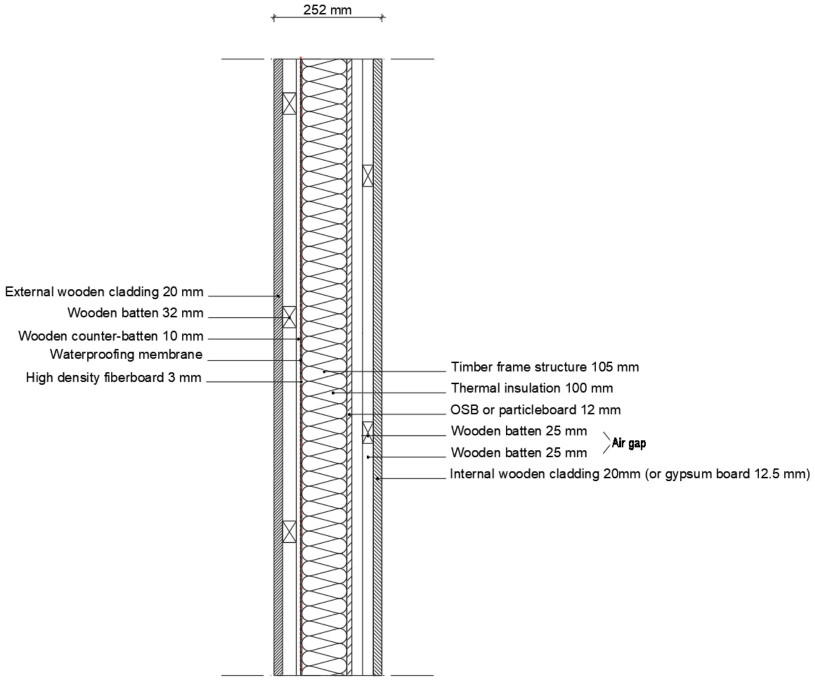
2 – TFS 145 – Interior horizontal wood cladding

Wall cross section:



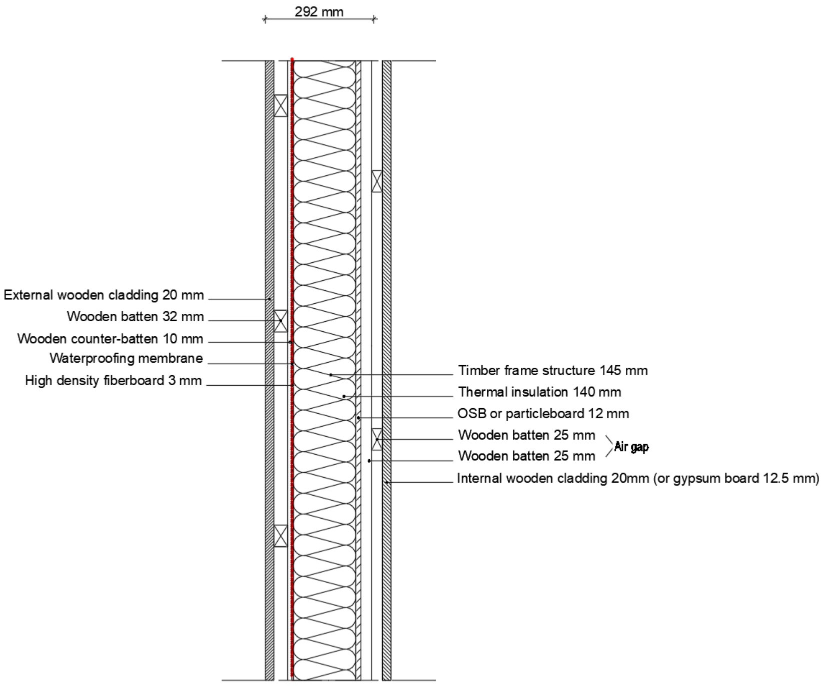
3 – TFS 105 – Interior vertical wood cladding

Wall cross section:



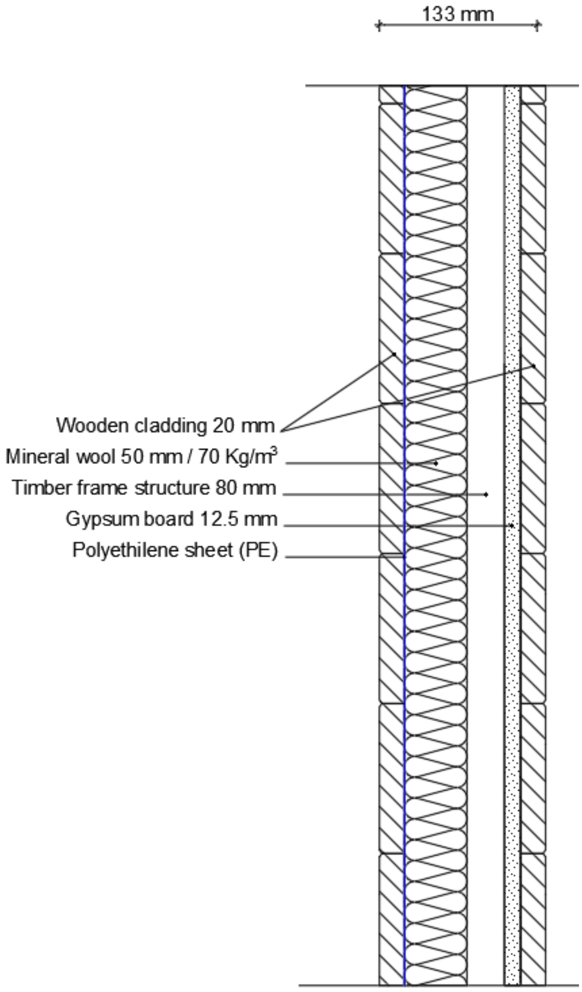
4 – TFS 145 – Interior vertical wood cladding

Wall cross section:



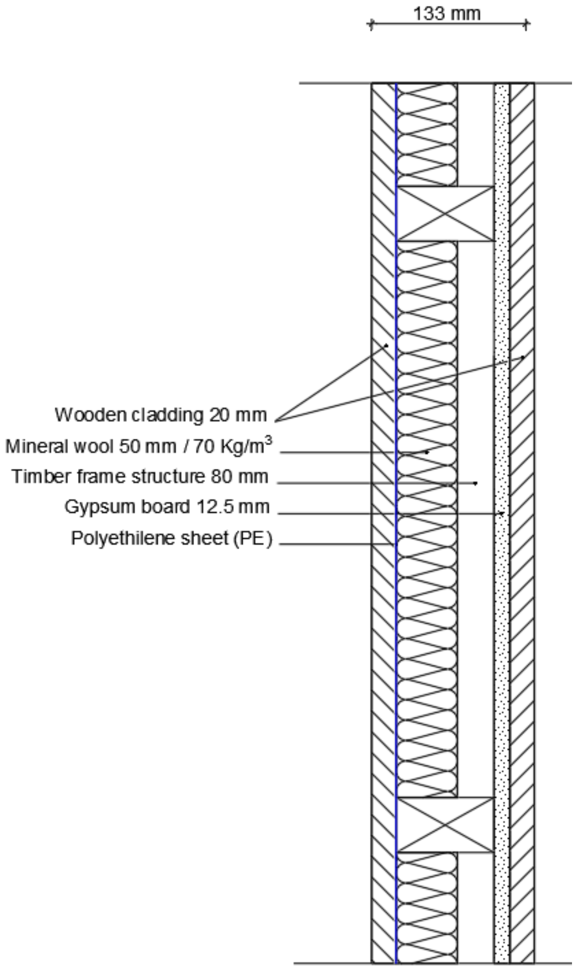
5 – TFS 80 – horizontal wood cladding

Wall cross section:



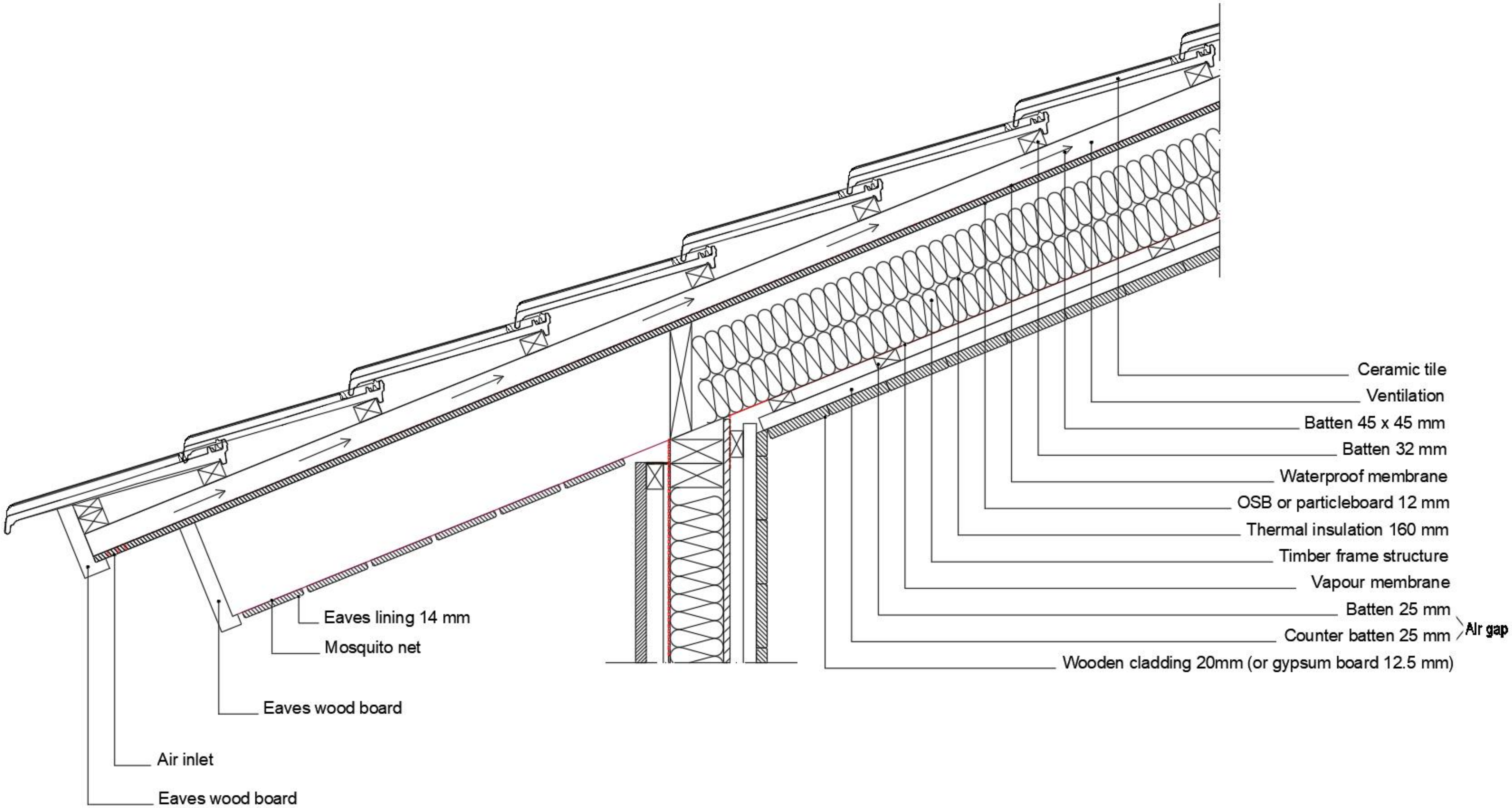
6 – TFS 80 – vertical wood cladding

Wall cross section:



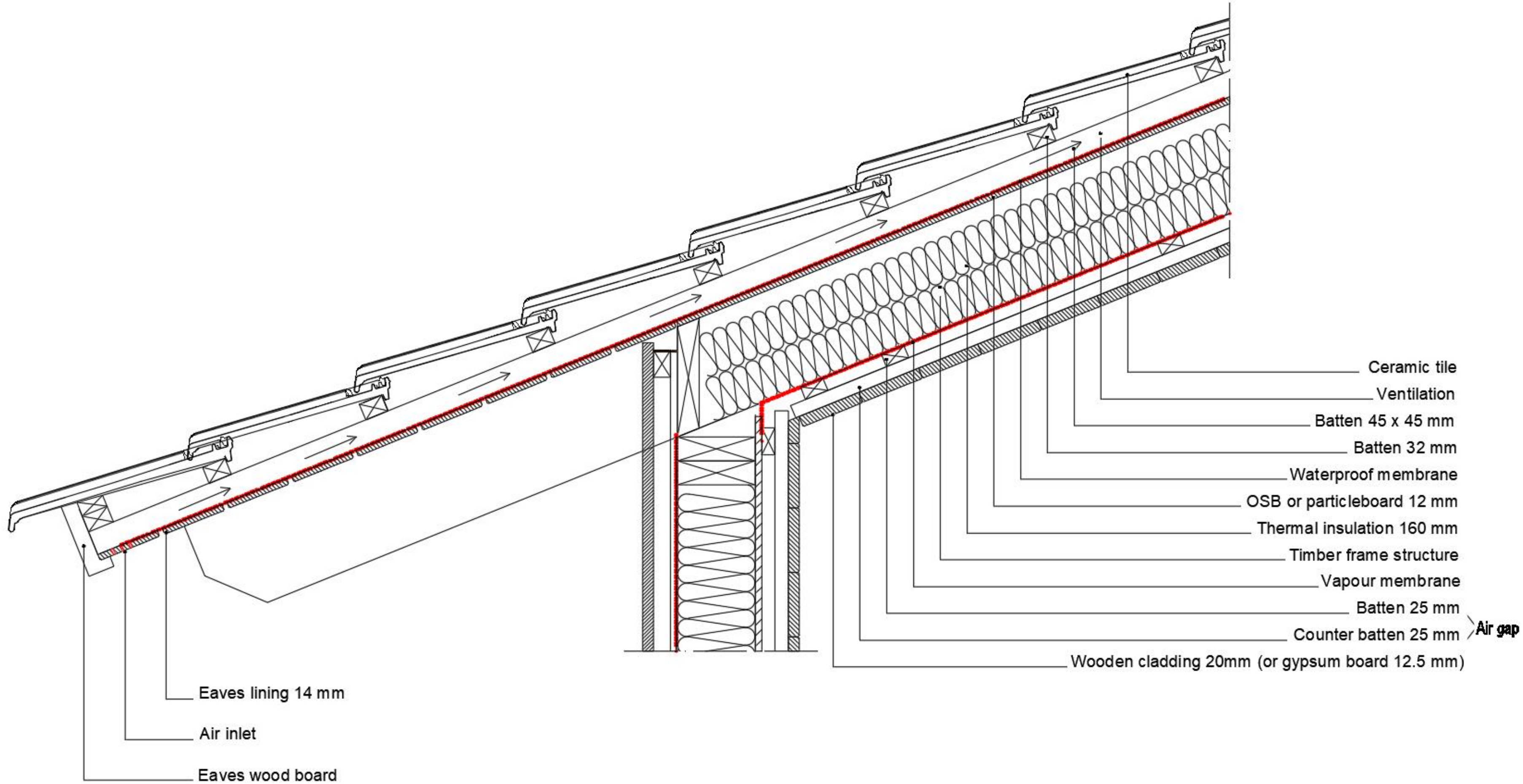
7 – Roof panel with hidden rafters

Roof transversal section:



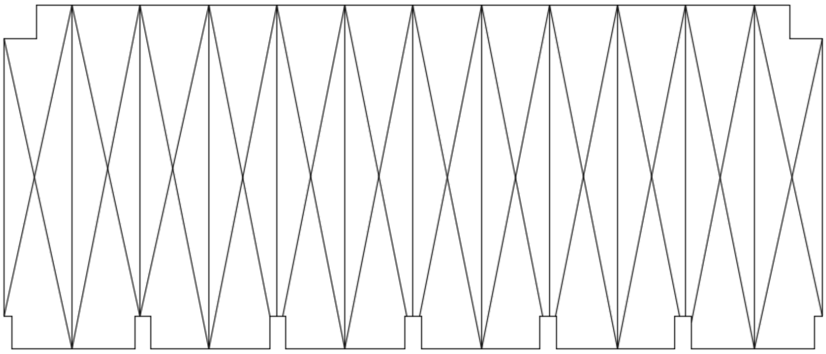
8 – Roof panel with visible rafters

Roof transversal section:

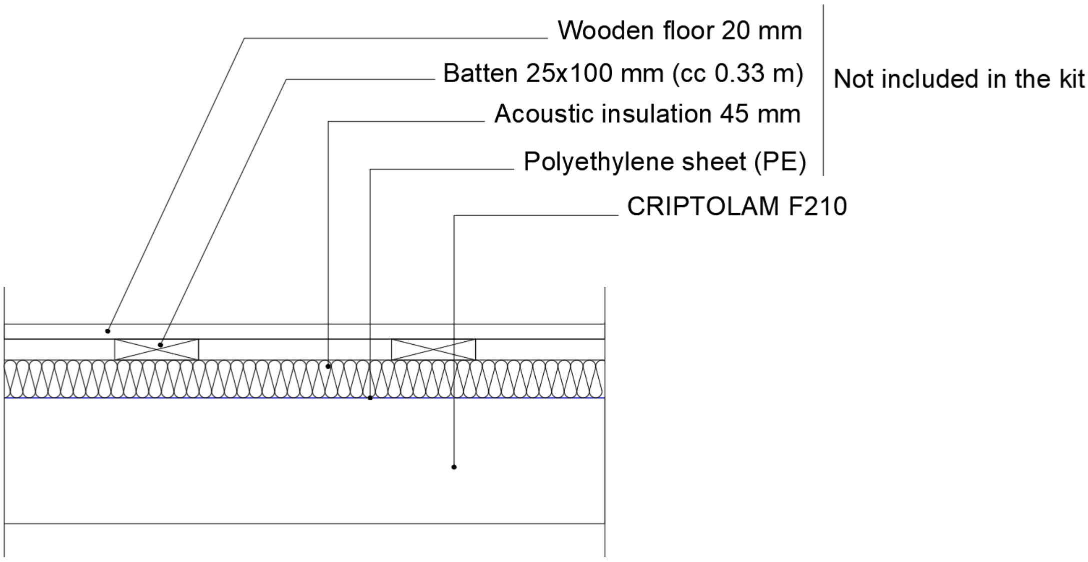


9 – CRIPTOLAM F210

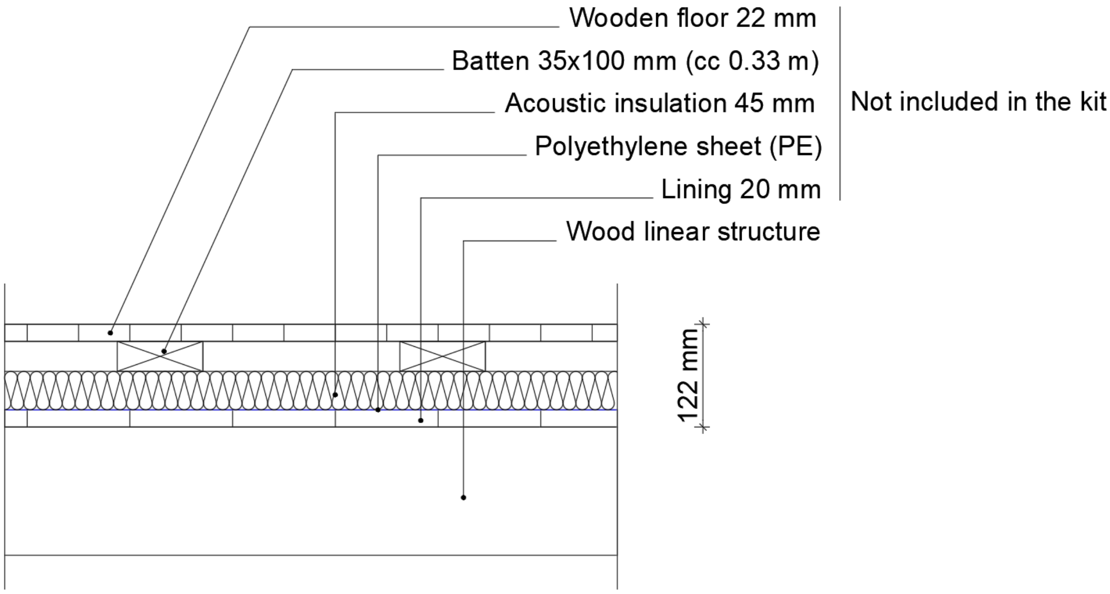
Floor transversal cross section (without coating layers):



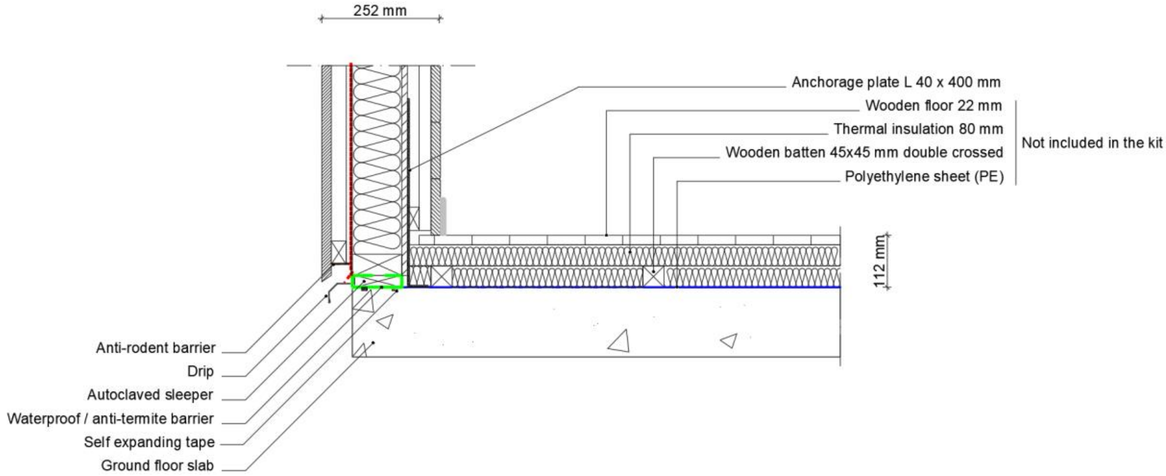
Floor longitudinal cross section (with coating layers):



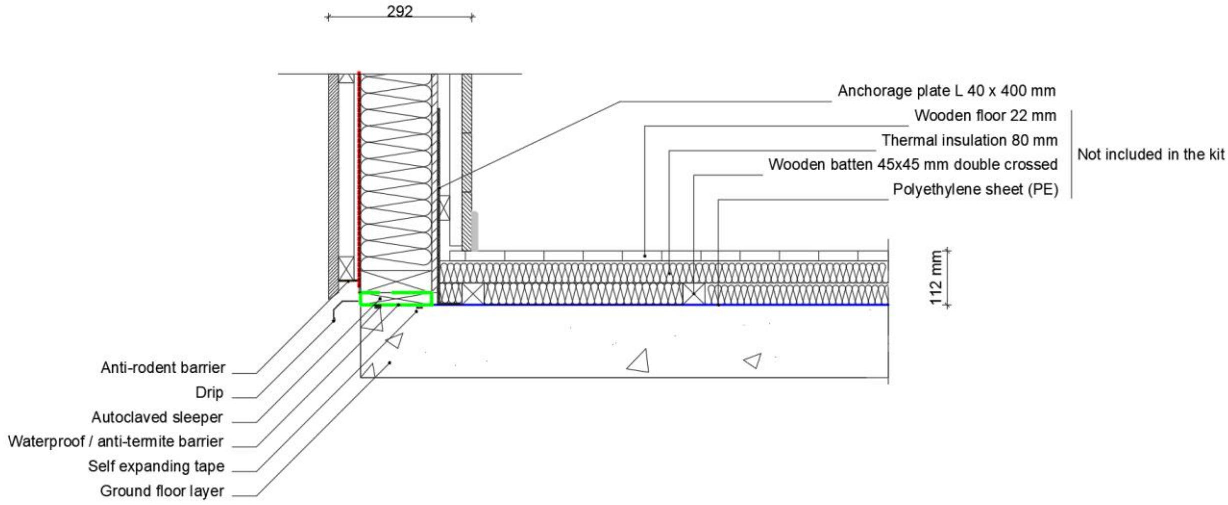
10 – Floor panels composed of linear wooden structural elements



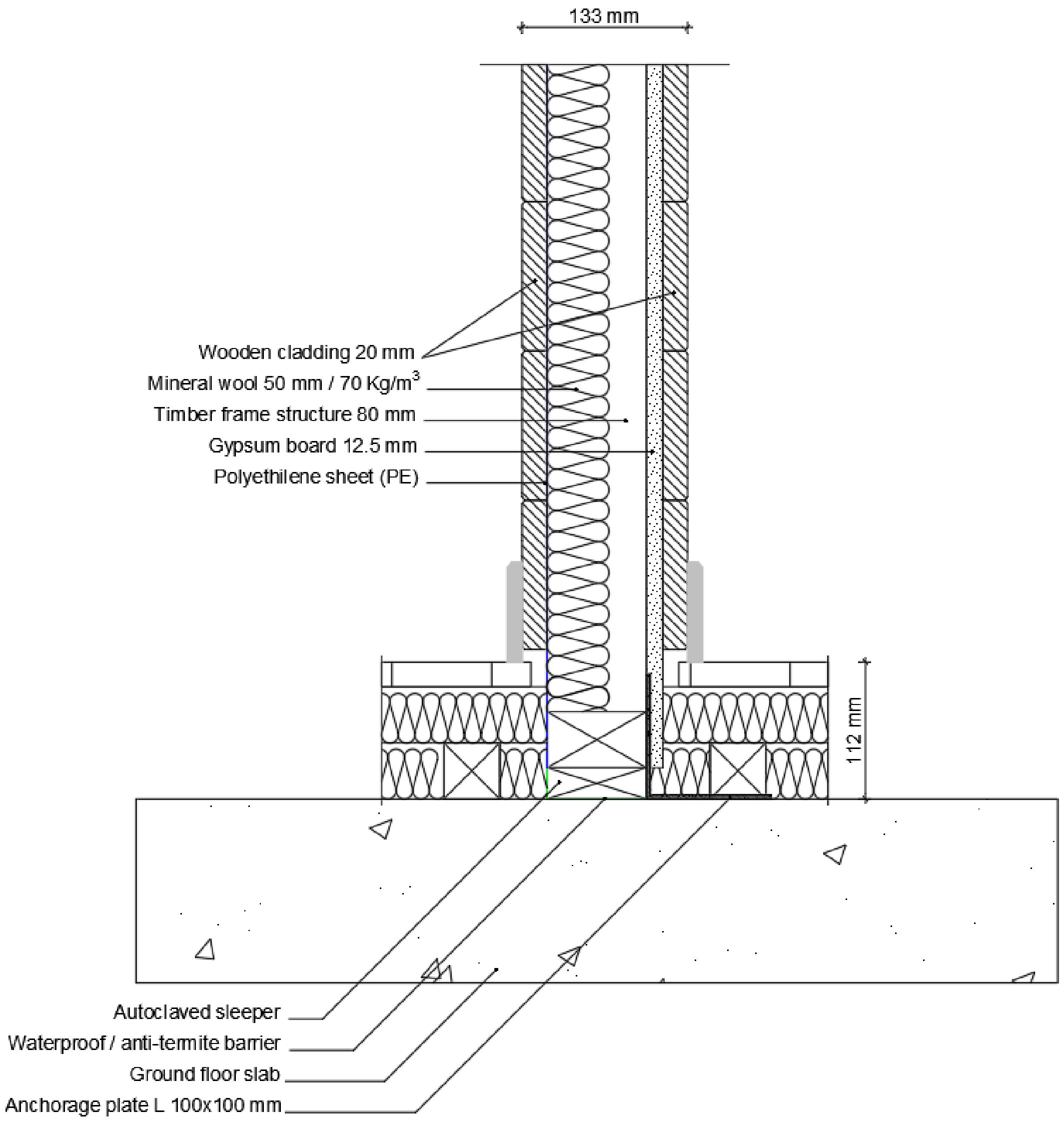
11 – TFS 105 – ground floor



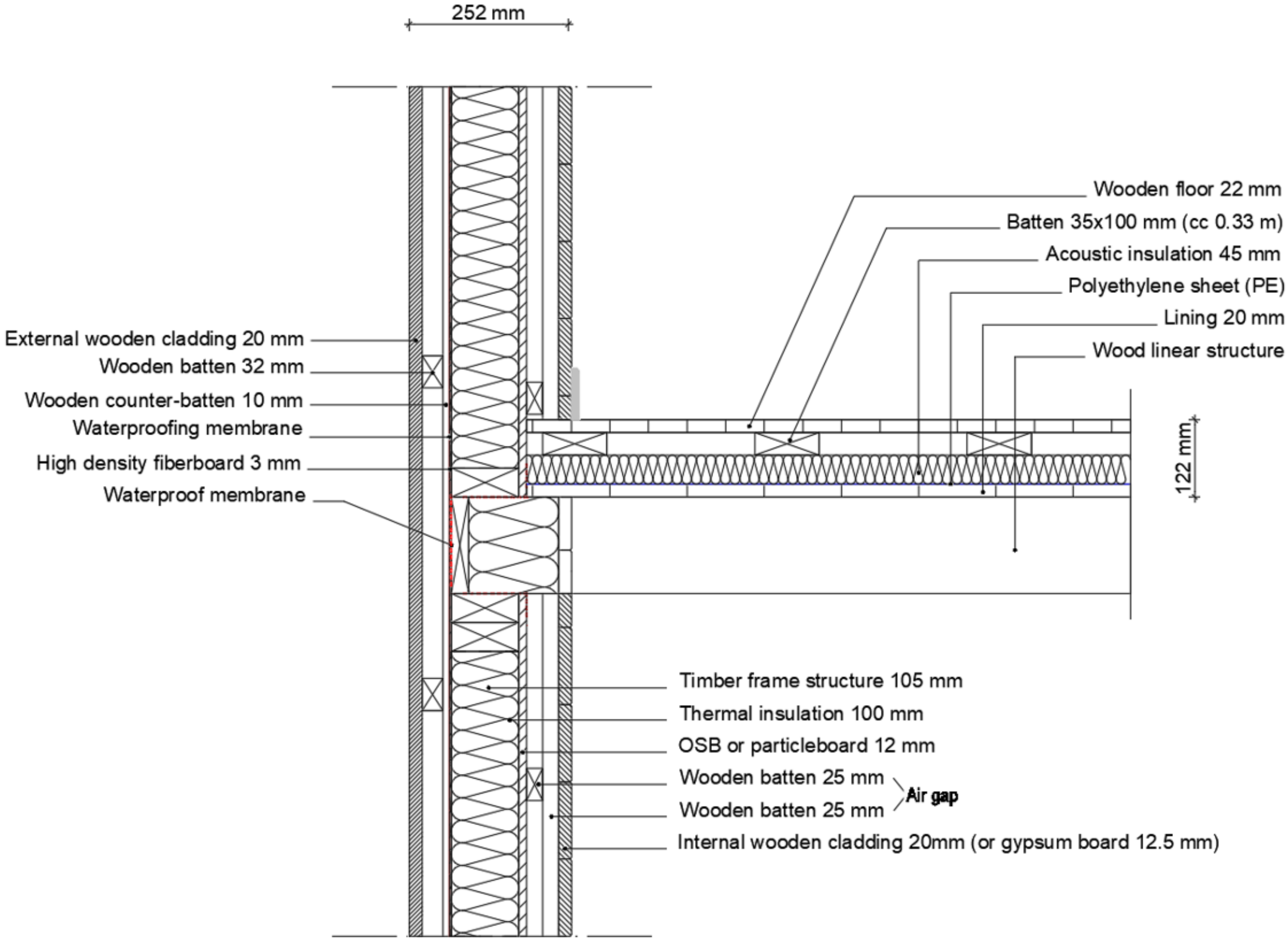
12 – TFS 145 – ground floor



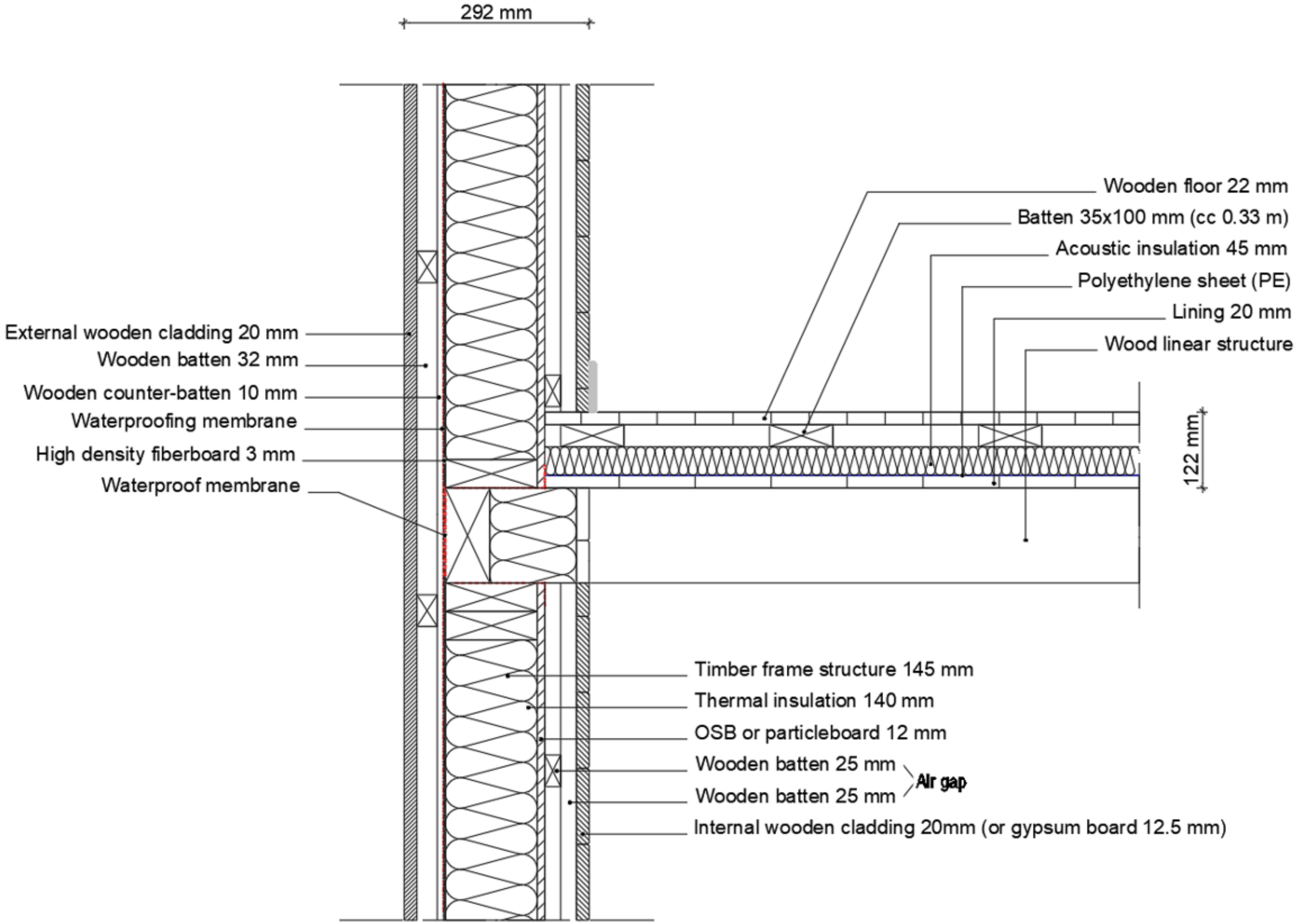
13 – TFS 80 – ground floor



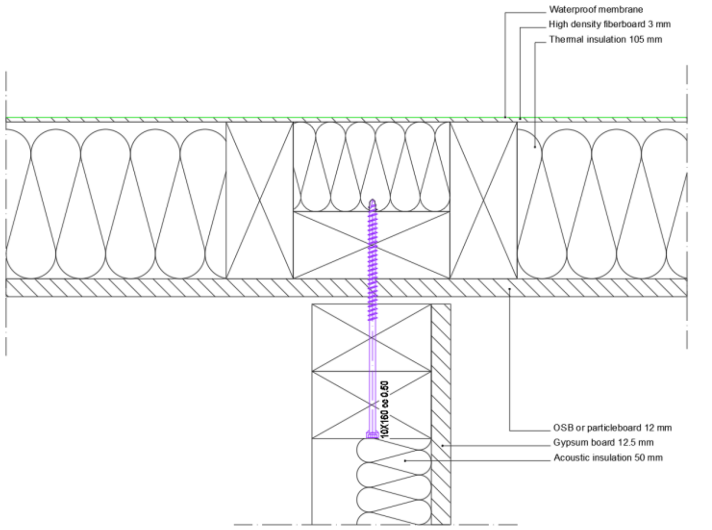
14 – TFS 105 – Floor panels composed of linear wood strucutre



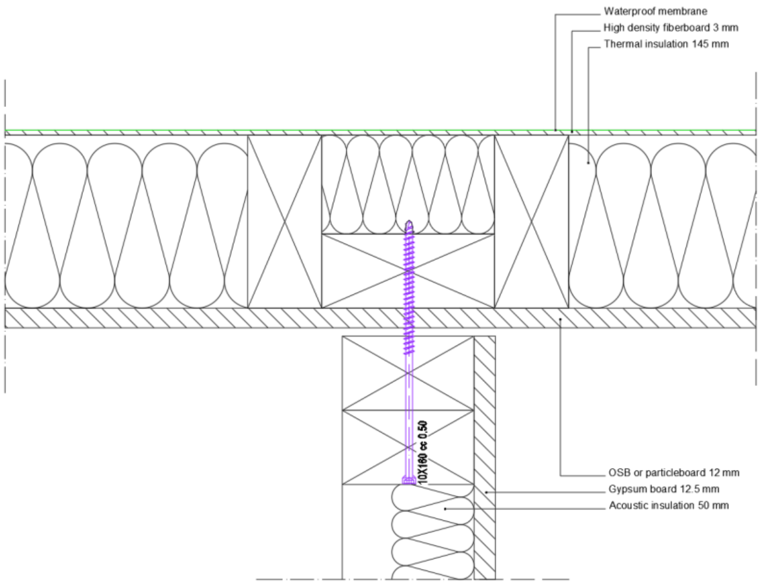
15 – TFS 145 – Floor panels composed of linear wood strucutre



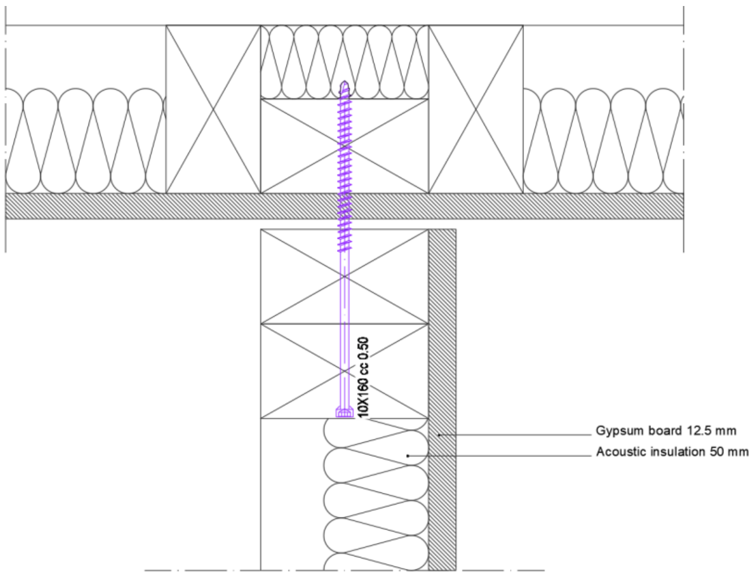
16 – TFS 105 – interior wall



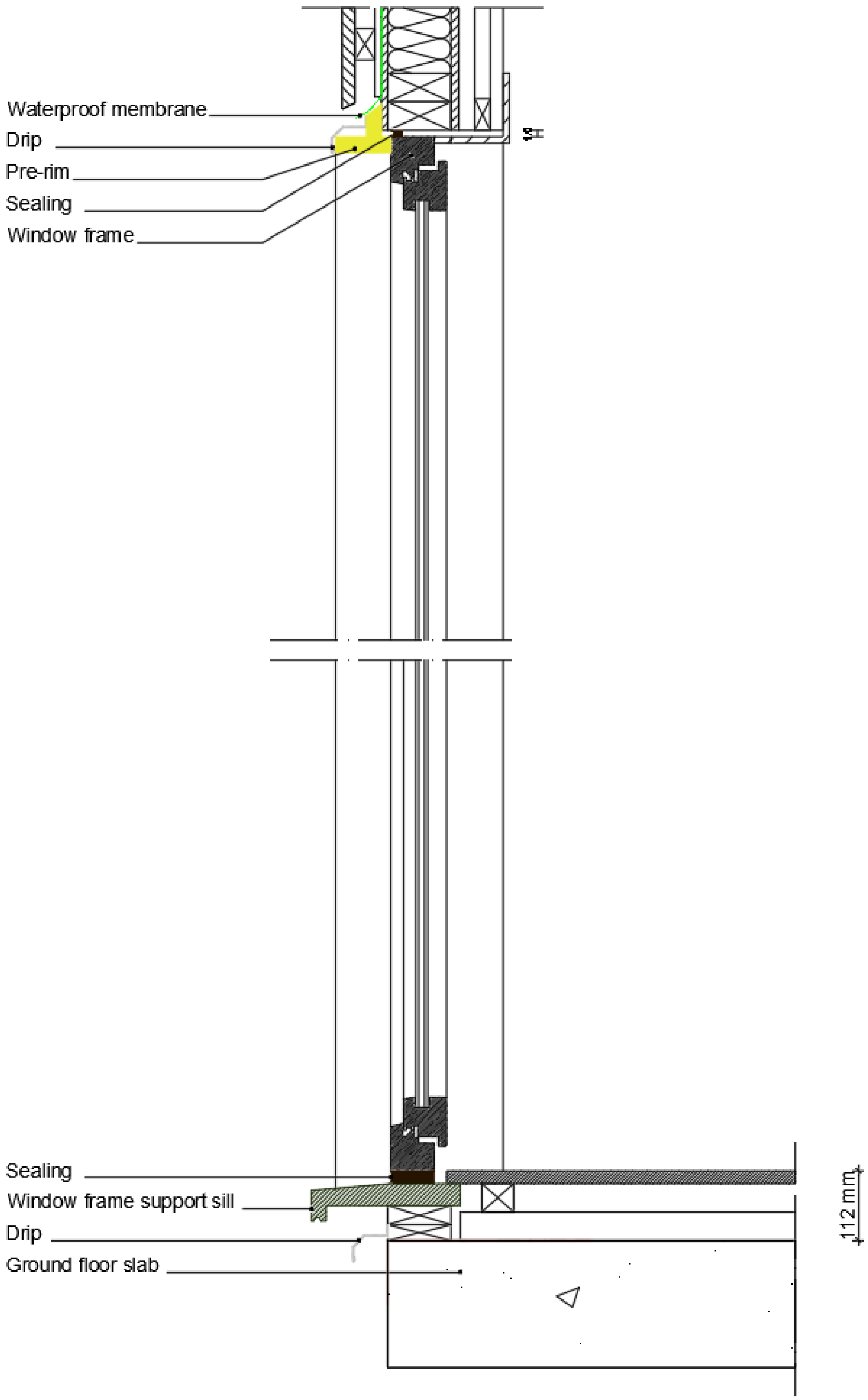
17 – TFS 145 – interior wall



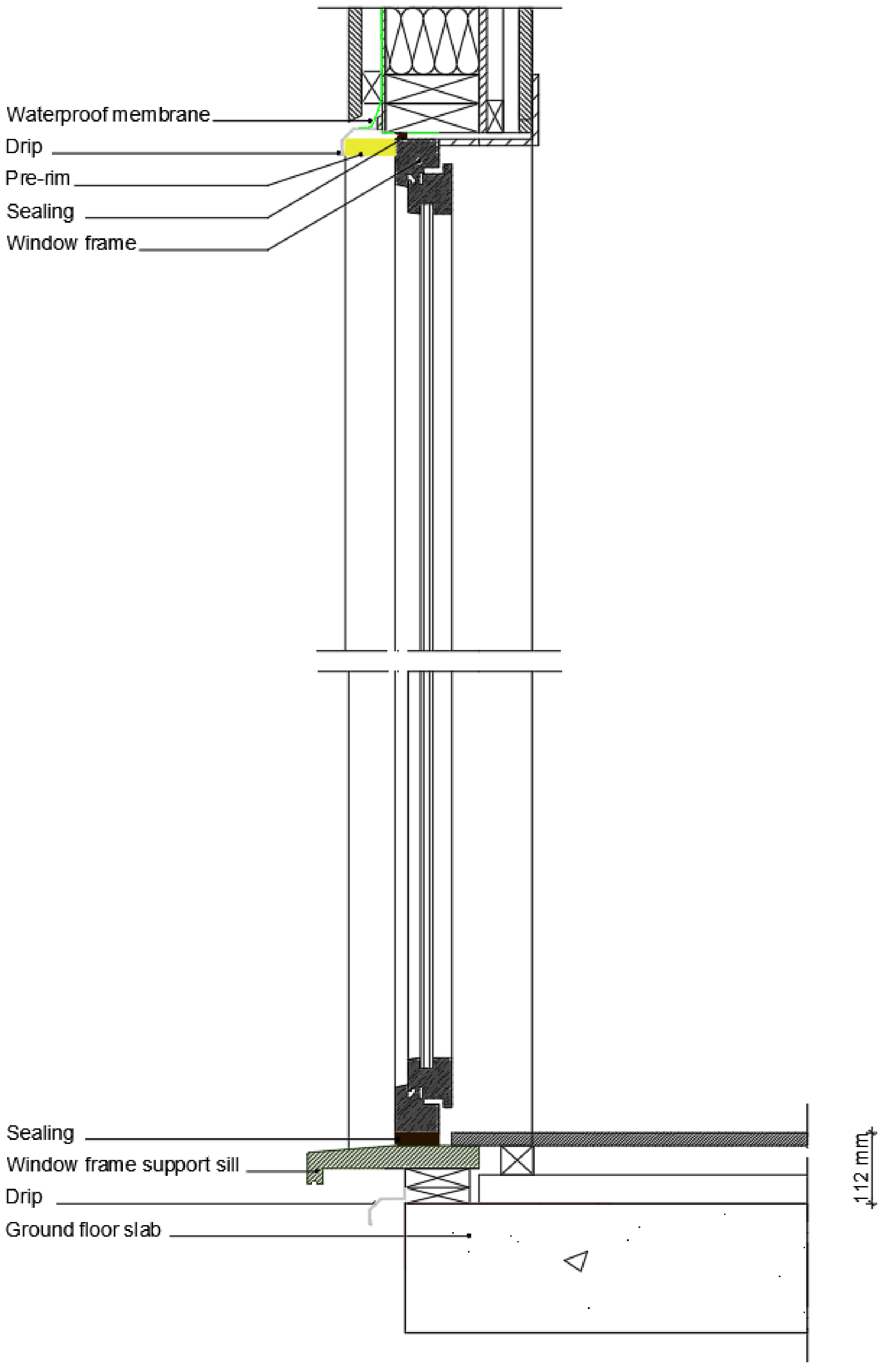
18 – Interior wall – interior wall



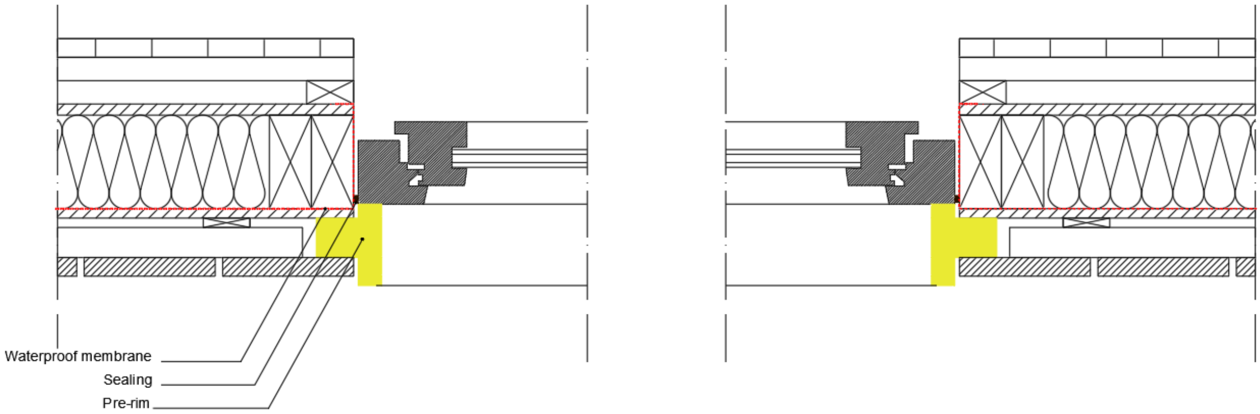
19 – TFS 105 – window (transversal cross section)



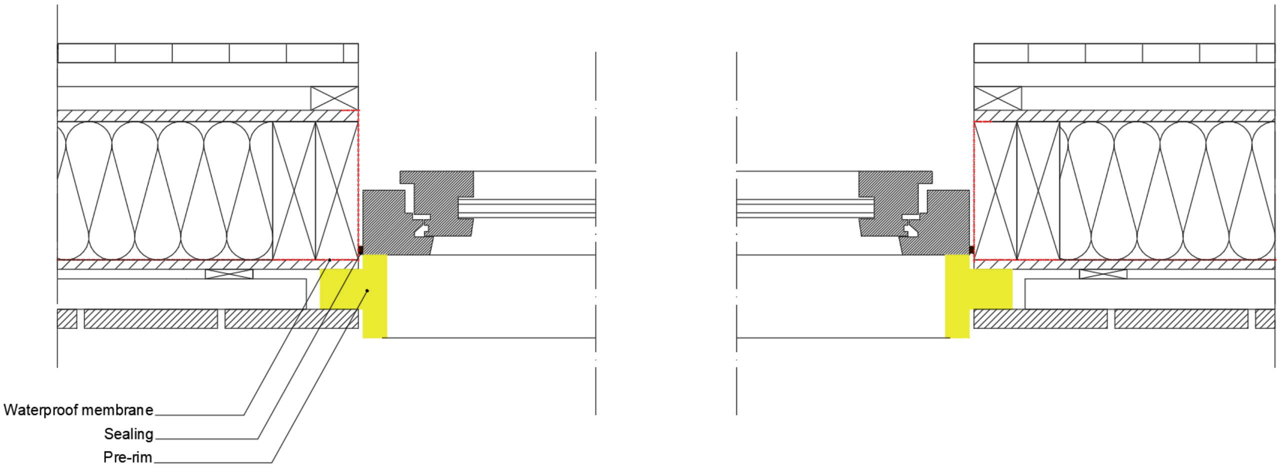
20 – TFS 145 – window (transversal cross section)



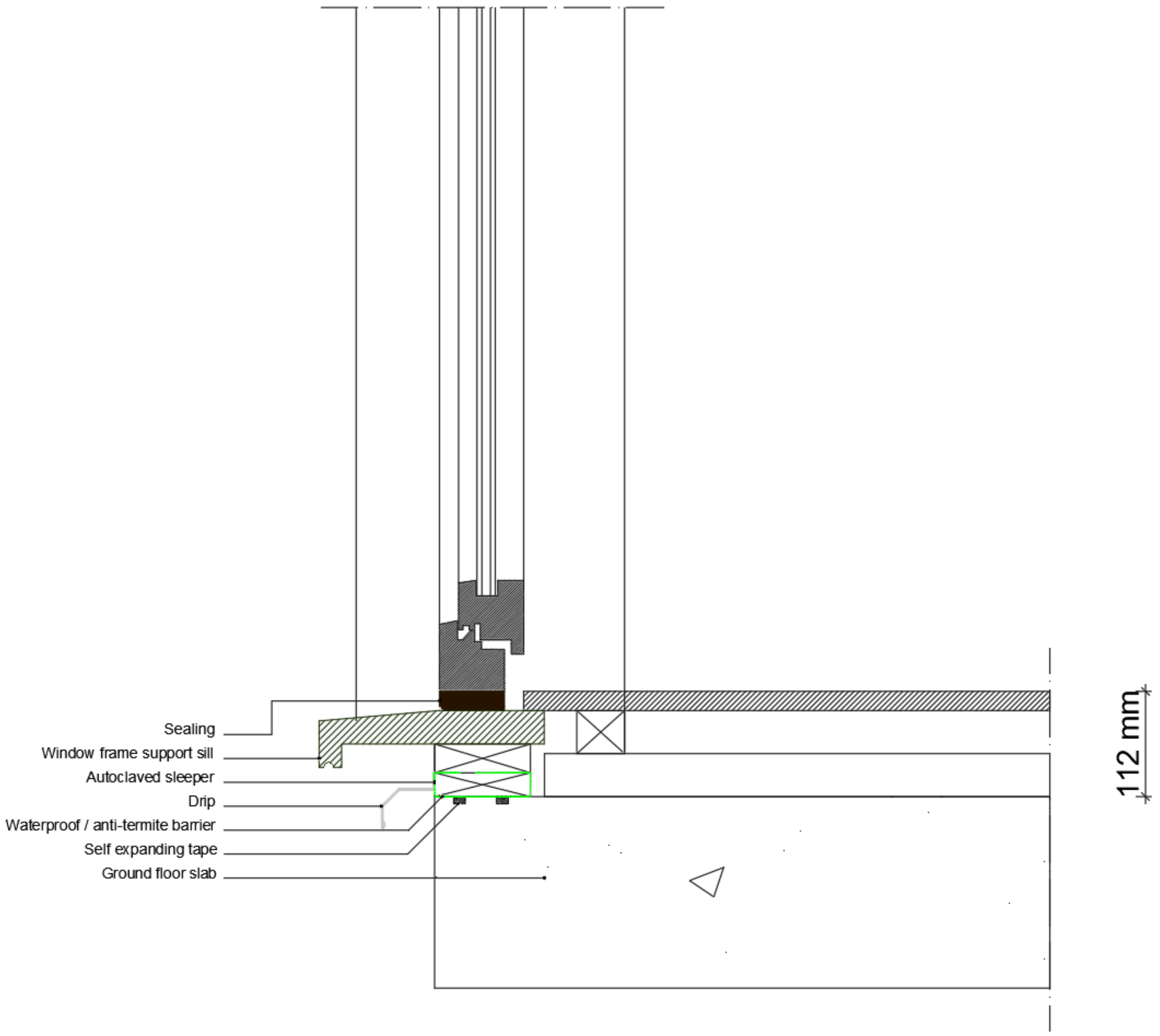
21 – TFS 105 – window (longitudinal cross section)



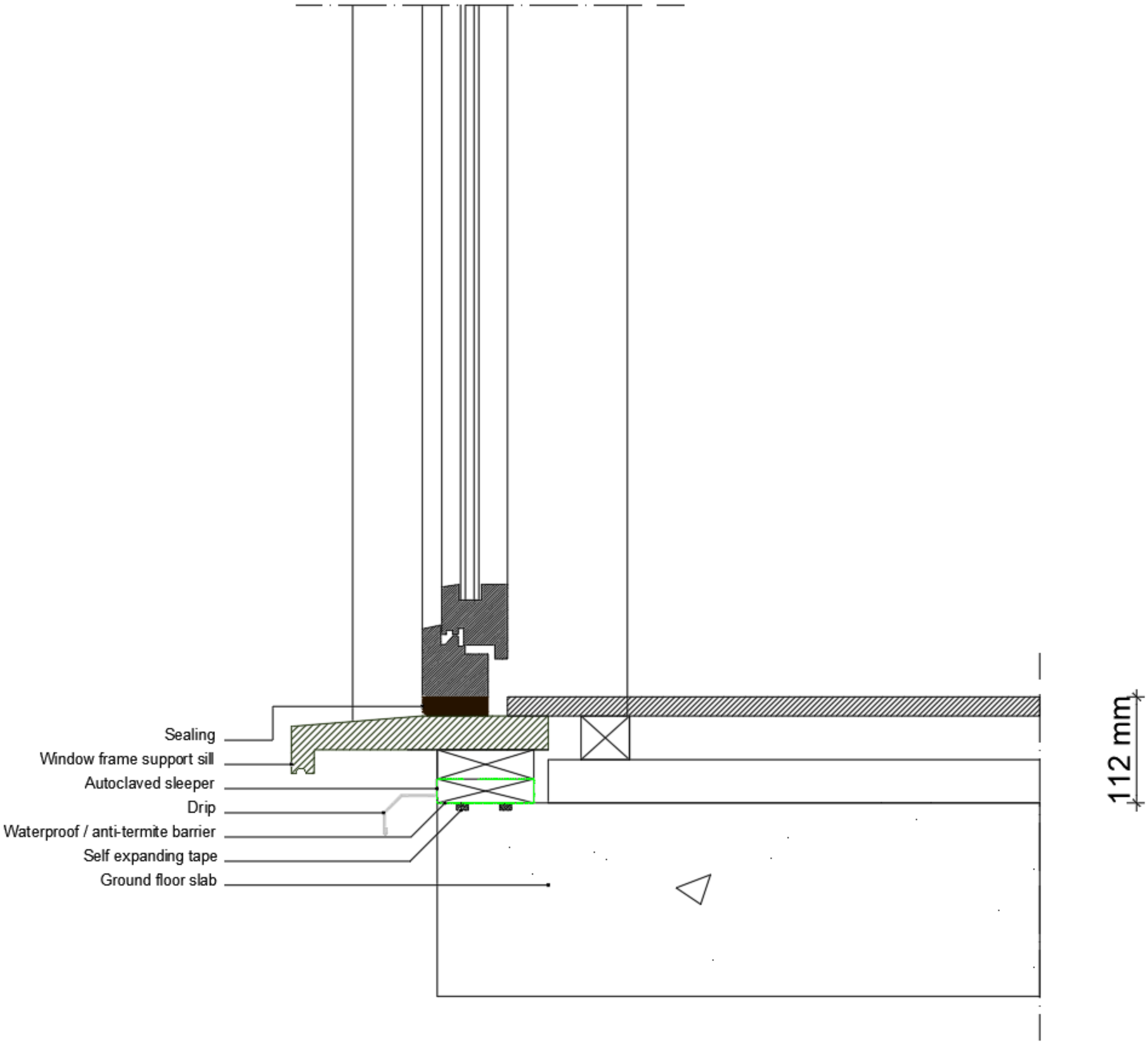
22 – TFS 145 – window (longitudinal cross section)



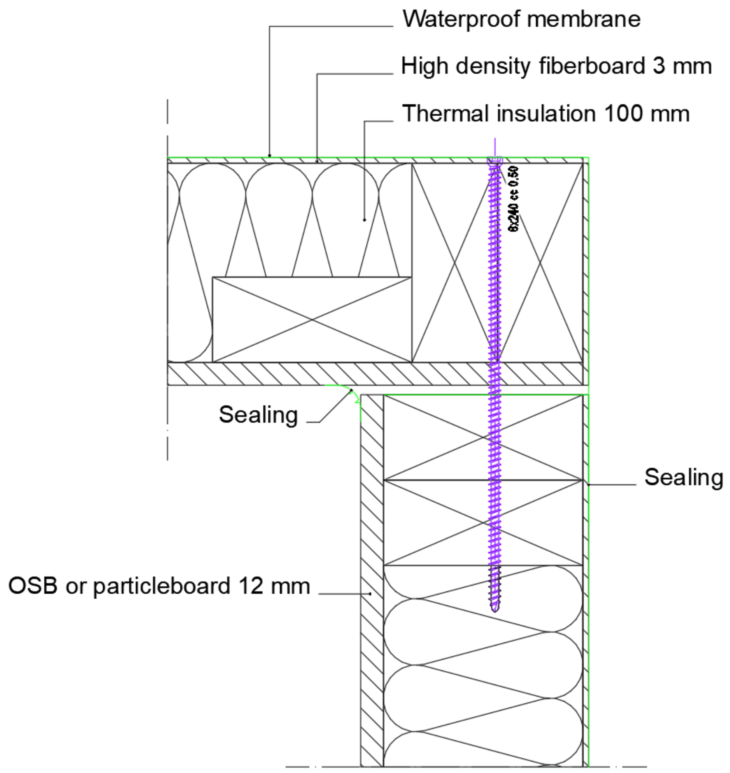
23 – TFS 105 – sill



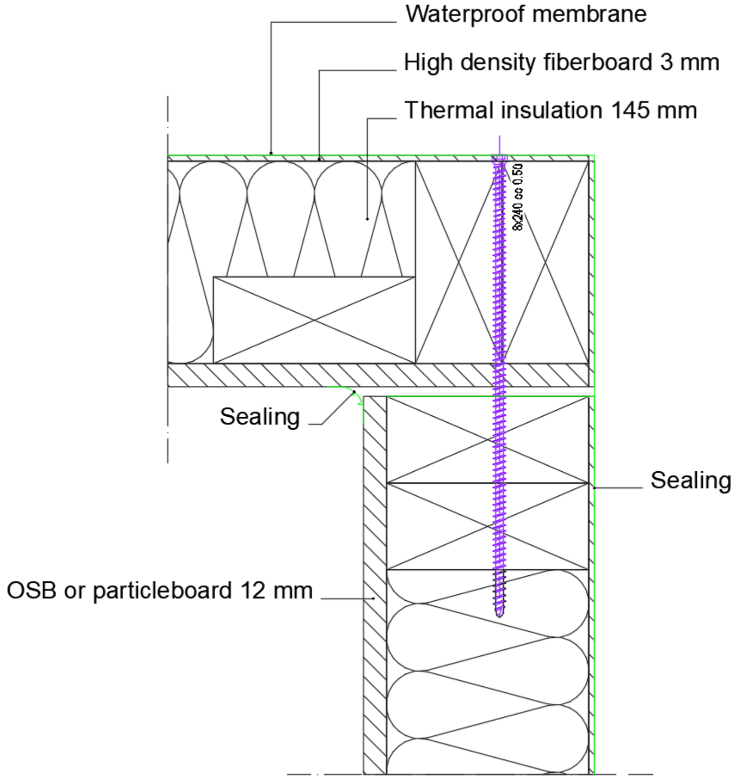
24 – TFS 145 – sill


Sealing
Window frame support sill
Autoclaved sleeper
Drip
Waterproof / anti-termite barrier
Self expanding tape
Ground floor slab
112 mm

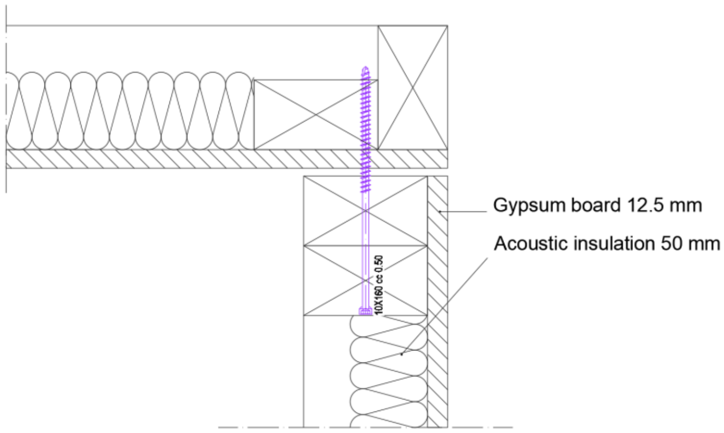
25 – Exterior corner TFS 105



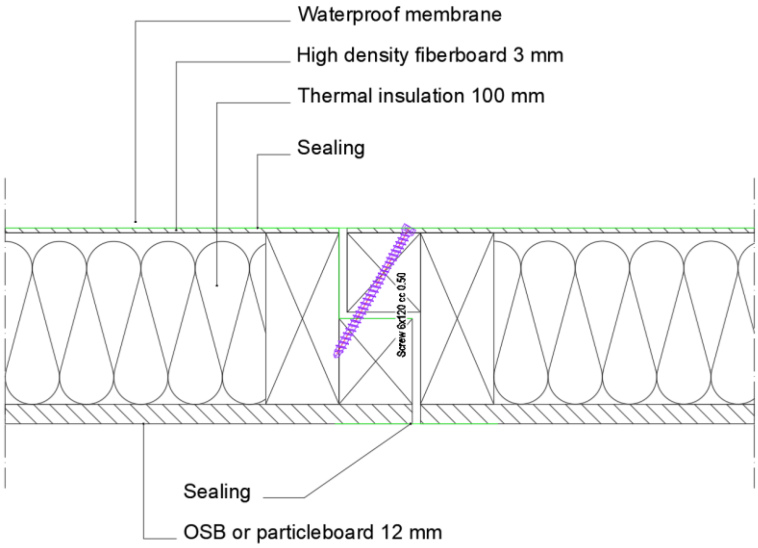
26 – Exterior corner TFS 145



27 – Interior corner TFS 80



28 – TFS 105 longitudinal joint



29 – TFS 145 longitudinal joint

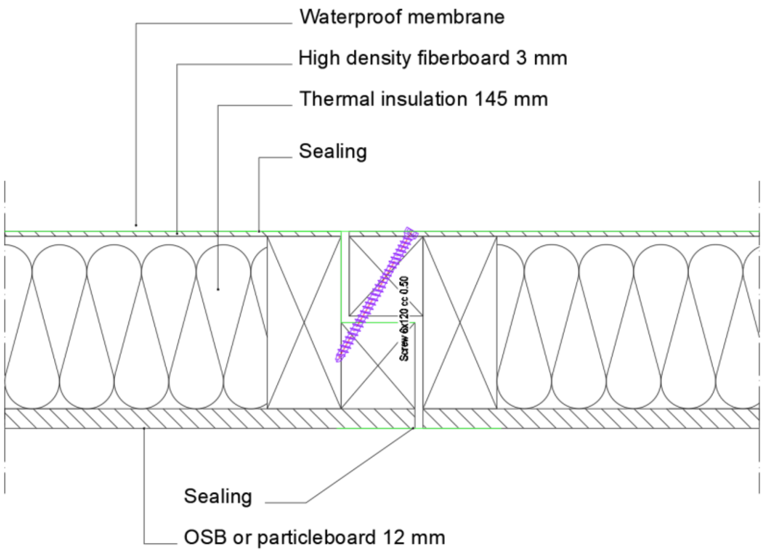


Table A.1 – Materials and products specifications

Product	Technical Specification	ρ (Kg/m³)	λ (W/mK)	μ (-) or Sd (m)	C (J/kgK)	Reaction to fire EN 13501-1+A1
Particleboard 12 mm (e.g. Durelis Vaporblock)	CE Marking acc. EN 13986+A1:2015	---	0.14	μ = 192 (wet) μ = 510 (dry)	---	D-s2,d0
		Formaldehyde class: E1 Formaldehyde content: ≤ 8 mg/100g Biological durability: class 1 and 2				
Particleboard 18 mm (e.g. Durelis)	CE Marking acc. EN 13986+A1:2015	---	0.14	μ = 16 (wet) μ = 50 (dry)		D-s2,d0
		Formaldehyde class: E1 Formaldehyde content: < 8 mg/100g DS Biological durability: class 1 and 2				
Universal single-sided tape without release liner (e.g., SPEEDY BAND)	---	---	---	Sd = 40 m	---	---
OSB (12 mm, e.g. SWISS KRONO OSB 3)	CE Marking acc. EN 13986:2004+A1:2015	650	0.13	μ = 76 (wet) μ = 123 (dry)	---	D-s2, d0
		Formaldehyde class: E1 Biological durability: class 2				
OSB for roof panels (18 mm, e.g., SWISS KRONO OSB 3)	CE Marking acc. EN 13986:2004+A1:2015	605	0.13	μ = 86	---	D-s2, d0
		Formaldehyde class: E1 Biological durability: class 2				
High density fiberboard (e.g., Betanzos HB)	CE Marking acc. EN 13986:2004+A1:2015	---	---	---	---	---
Gypsum Board (e.g., GYPFOR AQUA)	CE Marking acc. EN 520:2004+A1:2009	---	0.25	μ = 10	---	A2-s1, d0
Wood Fibre 1 (e.g., STEICO flex F 038)	CE Marking acc. EN 13171:2012+A1:2015	50	0.038	μ = 2	---	E
Wood Fibre 2 (e.g., STEICO flex F 036)	CE Marking acc. EN 13171:2012+A1:2015	55	0.036	μ = 2	---	E
Anti-birds net for the air ventilation gap in the roof (e.g., Riwega)	---	Metal or PVC anti-birds Flexible net of the air ventilation gap in the roof				
Mineral wool – walls (e.g., Alpharock 225)	CE Marking acc. EN 13162:2012+A1:2015	70	0.034	μ = 1	---	A1
Mineral wool – roof (e.g., Roulrock Kraft 80)	CE Marking acc. EN 13162:2012+A1:2015	22 to 27	0.040	---	---	---
Flexible sheet for waterproofing – Plastic and rubber vapour control layers (e.g., VAPOR IN 120)	CE Marking acc. EN 13984:2013	290	0.3	Sd = 25 m	---	E
Resilient soundproofing profile (e.g., ALADIN STRIPE)	---	---	---	---	---	E
PE Membrane (e.g. alberplás)	---	920 – 940	---	---	---	---
Bolt for wooden floor (e.g., INEMER – Cavilhas para soalho)	---	Reference: 6 x 80 Zn Amr Dimensions: 6 x 80 mm Material: Steel 200 HV				
Dowel (e.g., WORLDFIX S.A. BUCHA CH)	---	Reference: BUCHA CH Dimensions: 10 x 80 mm				
Linen insulating band (e.g., ISOLINA)	ISO 8301 DIN 52615 EN ISO 12571	---	0.038	μ = 1 – 2	1600	E

Product	Technical Specification	ρ (Kg/m³)	λ (W/mK)	μ (-) or Sd (m)	C (J/kgK)	Reaction to fire EN 13501-1+A1
Angle bracket (e.g., GH Angle Bracket WBR 100)	CE Marking acc. ETAG015	Reference: WBR 100 Dimensions: 100 x 100 x 90 x 3 (mm) Material: Stainless Steel Reaction to fire: A1 Durability: Corrosion protection for class 1 and 2 Characteristic load-carrying capacity: see ETA 09/0323				
Nailing plates for structural use (e.g., WHTPLATE440)	CE Marking acc. EN 14545:2008	Reference: WHTPLATE440 Dimensions: 60 x 440 mm² Thickness: 3.0 mm Material: DX51D Corrosion: Z275 Durability: Service class 1 – 2 (EN 1995 – 1 – 1)				
Metal drip edge	---	Material: Stainless Steel				
self-expanding sealing tape	CE Marking acc. EAD 320001-00-0605	---	0.043	Sd < 0.5 m	---	B1
Varnish (e.g., IGUALAK IL-201)	---	Ford viscosity cup №4 = 1000 cps Density = 1.04 gr/cm³ Solids = 33% pH = 8				
Waterproof membrane (e.g., TRASPIR ZENIT UV 210)	CE Marking acc. EN 13859-1/2:20114	---	---	Sd = 0.15	---	E
Waterproof anti-termite barrier for foundations	CE Marking acc. EN 13967:2012 + A1:2017	± 1000	0.4	Sd = 232 m	1800	F
Structural laminated veneer lumber (e.g., STEICO LVL X)	CE Marking acc. EN 14374:2004	530	---	---	---	D-s1,d0
		Formaldehyde class: E1 Biological durability: 4				
Structural laminated veneer lumber for bridges and buildings (e.g., STEICO LVL R)	CE Marking acc. EN 14374:2004	525	---	---	---	D-s1,d0
		Formaldehyde class: E1 Biological durability: 4				
Glue (e.g., AkzoNobel)	---	Reference: Cola MUF 1247 Viscosity: 10000 – 25000 mPas pH: 9.5 – 10.7 Dry extract: 64 – 69% Density: ± 1270 kg/m³ Formaldehyde content: 0.8%				
Hardener (e.g., AkzoNobel)	---	Reference: Endurecedor 2526 Viscosity: 1700 – 2700 mPas pH: 1.3 – 2.0 Density: ± 1070 kg/m³ Without formaldehyde				
PU Glue (e.g., Soudal Pro 45P)	---	Reference: Pro 45P Total solid content: 95% Temperature resistance: -30°C – 100°C Pressing pressure: 1 kg/cm² – 1.2 kg/cm² Water resistance: D4 Shear strength: > 10MPa				
PU Foam (e.g., Soudafoam GUN)	---	Density: 17 kg/m³ Acoustic insulation: 58 dB Compression resistance: Ca. 2.0 N/cm² Shear resistance: Ca. 4.0 N/cm² Temperature resistance: -40°C – 90°C Water absorption: 1% volume				
Clip connectors	CE Marking acc. ETAG 015	Reaction to fire: A1 Durability: Corrosion protection for class 1, 2 and 3 Mechanical resistance: see ETA 10/0189				

Product	**Technical Specification**	**ρ (Kg/m³)**	**λ (W/mK)**	**µ (-) or Sd (m)**	**C (J/kgK)**	**Reaction to fire EN 13501-1+A1**
Joist bearing for timber/concrete	CE Marking acc. ETAG 015	Reference: Alumidi Reaction to fire: A1 Durability: Corrosion protection for class 1 and 2 Mechanical resistance: see ETA 09/0361				
Support of timber columns and posts as load-bearing elements	CE Marking acc. ETAG 015	Reaction to fire: A1 Durability: Corrosion protection for class 1, 2 and 3 Mechanical resistance: see ETA 10/0422				
Cryptomeria japonica	NP 4544 EN ISO 10456	ρ_m = 350 (Quality class CYS I) ρ_m = 290 (Quality class CYS II)	0.09	50	1600	---
Pines radiata	EN 1611-1:2010 EN ISO 10456	500	0.13	50	1600	---
Picea abies	EN 1611-1:2010 EN ISO 10456	440 – 480	0.12	50	1600	---
Pinus sylvestris	EN 1611-1:2010 EN ISO 10456	500 – 540	0.13	50	1600	---
Self-tapping screws and threaded rods	CE Marking acc. EAD 130118-01-0603	Reaction to fire: A1 Durability: Corrosion protection for class 1 and 2 Mechanical resistance: see ETA 11/0030				
Connect band	CE Marking acc. 13984:2010	---	---	---	---	E

Table A.2 – Mechanical characteristics of the strucutural timber of the TFS kit

Mechanical characteristics	*Cryptomeria japonica* acc. NP 4544		Structural timber C18 acc. EN 14081-1 (EN 338)	Structural timber C24 acc. EN 14081-1 (EN 338)
	Quality class CYS I	Quality class CYS II		
Bending strength (N/mm²)	19	12	18	24
Tension strength parallel to grain (N/mm²)	13	9	10	14.5
Tension strength perpendicular to grain (N/mm²)	0.4	0.4	0.4	0.4
Compression strength parallel to grain (N/mm²)	20	17	18	21
Compression strength perpendicular to grain (N/mm²)	2.2	1.8	2.2	2.5
Shear strength (N/mm²)	3.0	3.0	3.4	4.0
Modulus of elasticity (kN/mm²) Parallel to grain: mean value	7.0	5.8	9.0	11.0
Modulus of elasticity (kN/mm²) Parallel to grain: characteristic value	4.7	3.9	6.0	7.4
Modulus of elasticity (kN/mm²) Perpendicular to grain: mean value	0.24	0.19	0.30	0.37
Shear modulus (kN/mm²): mean value	0.44	0.36	0.56	0.69

Table A.3 – Mechanical characteristics of the strucutral laminated veneer lumber of the TFS kit according to EN 14374

Mechanical characteristics	Structural laminated veneer lumber (e.g., STEICO LVL X) Thickness 21-24 mm	Structural laminated veneer lumber (e.g., STEICO LVL X) Thickness 27-75 mm	Structural laminated veneer lumber for bridges and buildings (e.g., STEICO LVL R)
Bending strength – Edgewise, parallel to grain (depth 300 mm) (N/mm^2)	30	32	30
Bending strength – Size effect parameter (N/mm^2)	0.15	0.15	0.15
Bending strength – Edgewise, perpendicular to grain (depth 300 mm) (N/mm^2)	10	8	NPD
Bending strength – Flatwise, parallel to grain (N/mm^2)	32	36	32
Bending strength – Flatwise, perpendicular to grain (N/mm^2)	7	8	NPD
Tensile strength – Flatwise, parallel to grain (length 3000 mm) (N/mm^2)	21	22	NPD
Tensile strength – Edgewise, perpendicular to grain (N/mm^2)	7	5	NPD
Compressive strength – Parallel to grain (length 3000 mm) (N/mm^2)	26	30	38
Compressive strength – Edgewise, perpendicular to grain (N/mm^2)	9	9	7.5
Compressive strength – Flatwise, perpendicular to grain (N/mm^2)	4	4	3.0
Shear strength – Edgewise, parallel to grain (N/mm^2)	4.6	4.6	3.2
Shear strength – Edgewise, perpendicular to grain (N/mm^2)	4.6	4.6	NPD
Shear strength – Flatwise, parallel to grain (N/mm^2)	1.1	1.1	2.6
Shear strength – Flatwise, perpendicular to grain (N/mm^2)	1.1	1.1	NPD
Modulus of elasticity – Parallel to grain (mean value) (N/mm^2)	10000	10600	11000
Modulus of elasticity – Parallel to grain (characteristic value) (N/mm^2)	9000	9000	8900
Modulus of elasticity – Edgewise, perpendicular to grain (mean value) (N/mm^2)	3500	3000	NPD
Modulus of elasticity – Edgewise, perpendicular to grain (characteristic value) (N/mm^2)	2700	2300	NPD
Modulus of elasticity – Flatwise, perpendicular to grain (mean value) (N/mm^2)	1300	2500	NPD
Modulus of elasticity – Flatwise, perpendicular to grain (characteristic value) (N/mm^2)	1000	1800	NPD
Shear Modulus – Edgewise, parallel to grain (mean value) (N/mm^2)	600	600	500
Shear Modulus – Edgewise, parallel to grain (characteristic value) (N/mm^2)	400	400	350
Shear Modulus – Flatwise, parallel to grain (mean value) (N/mm^2)	150	150	NPD
Shear Modulus – Flatwise, parallel to grain (characteristic value) (N/mm^2)	130	130	NPD
Shear Modulus – Flatwise, perpendicular to grain (mean value) (N/mm^2)	150	150	NPD
Shear Modulus – Flatwise, perpendicular to grain (characteristic value) (N/mm^2)	130	130	NPD

Table A.4 – Mechanical characteristics of the Particleboards acc. EN 13986+A1:2015

Mechanical characteristics	12 mm	18 mm
Bending strength (N/mm²)	18	16
Modulus of elasticity in bending (N/mm²)	2550	2400
Internal bond (N/mm²)	0.45	0.45
Swelling in thickness, 24h (%)	11	10
Moisture resistance OPTION 1: internal bond (N/mm²)	0.25	0.22
Moisture resistance OPTION 1: swelling in thickness (%)	12	12
Strength – tension f_t (N/mm²)	9.4	8.3
Strength – compression f_c (N/mm²)	12.7	11.8
Strength – bending f_m (N/mm²)	15	13.3
Strength – panel shear f_y (N/mm²)	7	6.5
Strength – planar shear f_r (N/mm²)	1.9	1.7
Stiffness – tension E_t (N/mm²)	2000	1900
Stiffness – compression E_c (N/mm²)	2000	1900
Stiffness – bending E_m (N/mm²)	3500	3300
Stiffness – panel shear G_v (N/mm²)	960	930
Linear expansion $\delta l_{30,85}$ (mm/m)	<3	<3

Table A.5 – Mechanical characteristics of the OSB boards acc. EN 13986:2004+A1:2015

Mechanical characteristics	12 mm	18 mm
Bending strength – longitudinal/transversal (N/mm²)	20/10	18/9
Modulus of elasticity in bending – longitudinal/transversal (N/mm²)	3500/1400	
Internal bond (N/mm²)	0.32	0.30
Swelling in thickness, 24h (%)	≤ 15	
Durability (moisture resistance) – Bending strength (N/mm²)	8	7
Strength – bending f_m (N/mm²)	16.4	14.8
Strength – compression $f_{c,0}$ (N/mm²)	15.4	14.8
Strength – compression $f_{c,90}$ (N/mm²)	12.7	12.4
Strength – panel shear f_y (N/mm²)	6.8	

Mechanical characteristics	12 mm	18 mm
Stiffness – bending $E_{m,0}$ (N/mm²)	4930	
Stiffness – bending $E_{m,90}$ (N/mm²)	1980	
Stiffness – compression $E_{c,0}$ (N/mm²)	3800	
Stiffness – compression $E_{c,90}$ (N/mm²)	3000	
Stiffness – panel shear G_v (N/mm²)	1080	

ANNEX B

The maximum admissible loads and deformation of the panels CRIPTOLAM F210 were determined by numerical simulation based on experimental data.

The results are shown in the Table B.1.

Table B.1: CRIPTOLAM F210 maximum admissible load for a final maximum deformation of L/300 [mm]

Span [m]	**4.0**	**4.5**	**5.0**	**5.5**	**6.0**
Maximum load values [kN/m^2] beyond: panel self-weight + Q = 2.0 kN/m^2	6.50	4.00	2.40	1.30	0.55
Instantaneous deformation | S.L.S. – P_{sd} = G+Q					
Deformation [mm]	7.90	9.14	10.53	12.33	13.98
Maximum deformation (L/360) [mm]	11.11	12.50	13.89	15.28	16.67
Final deformation | S.L.S. P_{sd} = 1.8G+1.24Q					
Deformation [mm]	13.25	14.91	16.62	18.24	19.99
Maximum deformation (L/300) [mm]	13.33	15.00	16.67	18.33	20.00

The resistant capacity of CRIPTOLAM F210 panels, for the service limit state, was calculated using EN 1995-1-2 (Eurocode 5) method. The results are shown in the Table B.2.

Table B.2: Maximum admissible loads for CRIPTOLAM F210 panels beyond panel self-weight + Q = 200 kg/m^2 (P_{sd} = 1.8G+1.24Q)

	Limit [mm]	**Span [m]**				
		4.0	**4.5**	**5.0**	**5.5**	**6.0**
Maximum admissible loads [kg/m^2]	L/300	650	400	240	130	55
	L/200	1000	640	400	235	120