Market Readiness in Timber Construction: The Role of European Technical Assessments

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Abstract Timber construction has gained prominence due to its qualities such as sustainability, thermal performance, mechanical resistance, versatility, and aesthetics. These advantages have driven the development of numerous innovative wood-based construction systems. However, many systems enter the market without undergoing crucial experimental assessments, such as watertightness, air permeability, mechanical resistance, or acoustic performance. This lack of evaluation can lead to poorly adapted solutions for the buildings and building pathologies with potentially catastrophic consequences. European Technical Assessments (ETAs) provide a robust solution to mitigate these risks. Besides enabling CE marking, which facilitates the free circulation of construction products within the European market, ETAs allow experimental and numerical characterization of construction systems. For timber building kits, such evaluations can be conducted under EAD 340308-00-0404. Through case studies of two innovative solutions from Rusticasa-Construções, Lda.—a thermal log kit and a timber frame—this research not only elucidates how the CE marking process, based on the ETA voluntary route, facilitates market entrance, but also reinforces the reliability of wood as a construction material through standardized performance validation. The results obtained allow for a detailed characterization of the construction systems in key domains such as watertightness and air permeability, confirming that the evaluated solutions exhibit levels suitable for most applications; thermal insulation with high thermal resistance values; vapor permeability, where no risk of condensation was confirmed; and mechanical resistance, where the results obtained can be integrated into structural design. In addition to presenting the results of tests, this paper highlights the importance of

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collaboration between industry stakeholders and Technical Assessment Bodies to streamline the CE marking process and foster the adoption of wood-based systems. The experimental characterization conducted during the ETA issuance process benefits manufacturers, designers, installers, project owners, and other stakeholders in the construction sector. Thus, this work highlights the critical role of experimental assessment in safety, and market readiness of innovative timber construction systems.

Keywords Timber construction · European technical assessments · CE marking · Timber frame system · Log walls

1 Introduction

Wood has long been a fundamental material in construction, valued for its strength, versatility, and aesthetics. In recent years, the increasing demand for sustainable building solutions has further elevated the prominence of wood in the construction sector. Its favorable thermal performance, mechanical resistance, and reduced environmental impact make it an attractive alternative to conventional construction materials. As a result, a wide range of innovative wood-based construction systems has emerged, offering new possibilities for architects, engineers, and builders [1–3].

Despite these advantages, many of these innovative systems enter the market without undergoing essential experimental assessments. Critical performance aspects such as sustainability, thermal performance, mechanical resistance, fire behavior, watertightness, air permeability, and acoustic insulation are often not adequately assessed before commercialization. The absence of rigorous testing can lead to suboptimal construction solutions, structural defects, and long-term building pathologies with potentially severe consequences. Addressing this gap is crucial to ensure the reliability, safety, and durability of timber-based construction systems. This issue has also been addressed in other studies [4–8].

To mitigate these risks, European Technical Assessments (ETAs) provide a structured framework for the assessment of construction products. The ETA route enables CE marking, facilitating the European free circulation of construction materials while ensuring compliance with established performance criteria. For timber building kits, assessments can be performed under the European Assessment Document (EAD) 340308-00-0203—Timber Building Kits [9].

This paper presents the numerical and experimental studies related to two ETA processes implemented through two innovative timber solutions developed by Rusticasa-Construções, Lda.: a thermal log kit (ITS—Insulated Timber System, ETA 18/0984 [10]) and a timber frame system (TFS—Timber-Frame System, ETA 22/0889 [11]). These predesigned kits are factory-made and delivered for on-site assembly. This paper examines the ETA process through the case studies of two innovative timber construction solutions developed by Rusticasa-Construções, Lda.—a thermal log kit, referred to as ITS—Insulated Timber System (ETA 18/0984 [10]), and a timber frame system, referred to as TFS—Timber-Frame System (ETA 22/

0889 [11]). Both systems are predesigned timber building kits, manufactured in a factory for each individual building and delivered as a package to be assembled on-site. The kits include the main building components, such as external and internal walls, floors, and roof panels.

The studies cover tests, calculations, and results characterizing the systems under the Basic Work Requirements of the Construction Products Regulation [12]. It evaluates essential characteristics such as racking and compression resistance, condensation risk (WUFI2D), watertightness, air permeability, acoustic insulation, and thermal performance (Bisco software).

Therefore, this research highlights the essential role of experimental assessments in ensuring the safety and sustainability of modern timber construction. The following sections present the construction systems, methodology, results and conclusions.

2 Materials and Assessment Methods

2.1 Constructive Solutions Assessed

This section presents the assessed constructive solutions, specifically focusing on the external wall solutions, where the differences between them are substantial and for which the most tests and numerical calculations were conducted.

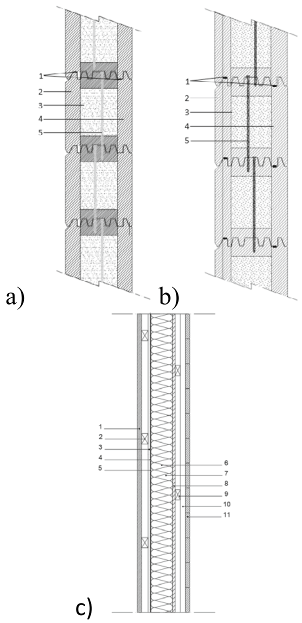
In the ITS system, the external walls are loadbearing and made of logs with integrated thermal insulation. ITS offers two types of wall panels, NATURLAM W180 Monolam or NATURLAM W180 Bilam (with maximum dimensions of 10 m × 3 m).

Regarding the TFS system, the external walls are loadbearing with a timber structure of 105 mm or (145 ± 5) mm thickness (with maximum dimensions of 3.0 m × 10.0 m).

The composition of the wall panels can be seen in Fig. 1.

2.2 Experimental and Numeral Assessment—Methods and Methodology

The assessments of these two constructive solutions followed the approaches outlined in EAD 340308-00-0203 [9], which are generally determined by testing standards and methods. In the following subsections, the tests or calculations carried out are presented.



Element composition (from outside to inside):

a) NATURLAM W180 Monolam
1 – Self-expanding sealing tape 10x10 mm
2 – Cryptomeria 40 mm
3 – Expanded Insulated Cork Board 100 mm
4 – Cryptomeria 40 mm
5 – Screw 6x240mm cc 1.0 m

b) NATURLAM W180 Bilam
1 – Self-expanding sealing tape 10x10 mm
2 – 2x Cryptomeria 20 mm
3 – Expanded Insulated Cork Board 100 mm
4 – Cryptomeria 40 mm
5 – Screw 6x240mm cc 1.0 m

c) TFS 105 / TFS 145
1 – External wooden cladding 20 mm
2 – Wooden batten 32 mm
3 – Wooden counter-batten 32 mm
4 – Waterproofing membrane
5 – High density fiberboard 3 mm
6 – Timber frame structure 105 mm / 145 mm
7 – Thermal insulation 100 mm / 140 mm
8 – OSB or particleboard 12 mm
9 – Wooden batten 25 mm
10 – Wooden batten 25 mm
11 – Internal wooden cladding 20 mm or gypsum board 12.5 mm

Fig. 1 Composition of the walls panels of the ITS system (**a**) and (**b**) and TFS system (**c**)

Mechanical Resistance and Stability

The mechanical resistance and stability of the wall panels were assessed through tests for shear resistance and stiffness in the plane direction against horizontal loads based on the racking test, according to EN 594 [13], and compression resistance, according to the procedure of EN 26891 [14] which applies only to log walls. For the shear resistance and stiffness, the test specimens consisted of a NATURLAM W180 Bilam wall panel, in the case of the ITS system, and a TFS 105 wall panel, in the case of the TFS system with dimensions of 2.4 m × 2.4 m, without openings. For the compression resistance, the test specimen was composed by a full-scale wall panel of NATURLAM W180 Bilam with dimensions of 10.0 m × 3.0 m and with 5 bracing elements. Figure 2 illustrates a test specimen during the racking test and during the compression resistance test.

Safety in Case of Fire—Reaction to Fire

Regarding safety in case of fire, the assessment was conducted based on the reaction to fire classification of the components that compose the assessed systems, in accordance with the guidelines established in Sect. 2.2.6 of EAD 340308-00-0203 [9].

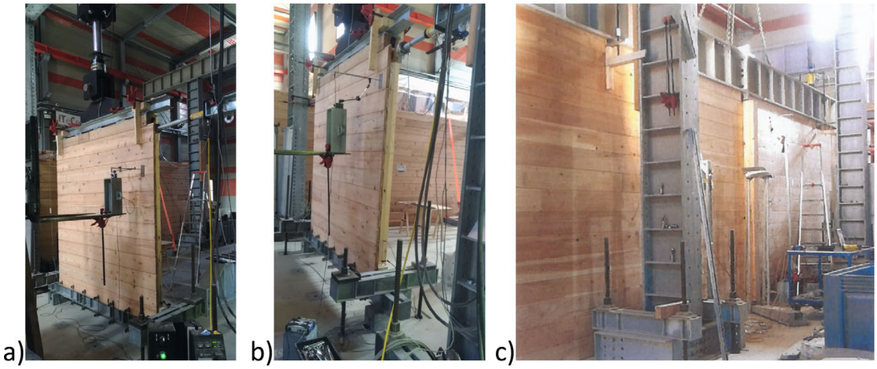


Fig. 2 Test specimens: **a** and **b** during the racking test; **c** during the compression test

Hygiene, Health and Environment

Water Vapour Resistance

Vapour permeability and moisture resistance of the external envelope were assessed based on calculations according to EN ISO 13788 [15], considering an internal humidity class of 2. The climate considered for the calculations was the climate of the city of Porto, Portugal. The calculations were carried out using WUFI 2D software.

Watertightness

The watertightness of the façade was assessed according to the indications given in the EAD [9]. For the ITS system, the watertightness of the façade was assessed according to EN 1027 [16]. The test specimens consisted of a log straight wall and a log corner wall made of NATURLAM W180 Bilam (see Fig. 3a and b). The log straight wall specimen was composed of 4 logs and 3 joints, with a total dimension of 1.2 m × 0.8 m. The total length of the joints was 3.57 m. The log corner wall specimen was made up of 2 straight log walls with a corner connection. The dimensions of the test specimen were 1.2 m × 1.0 m, totaling 10 logs and 8 joints. The total length of the joints was 8.24 m. For TFS system, the watertightness of the facade was assessed according to EN 12865 [17], procedure A. The test specimen was composed by a TFS 105 wall panel (see Fig. 3c) with dimensions of 1.2 m × 2.4 m.

Content, Emission and/or Release of Dangerous Substances

The emission of volatile organic compounds (VOC) and semi-volatile organic compounds (SVOC) from NATURLAM W180 Bilam was assessed according to EN 16516 [18]. The release scenario applicable was IA1: Product with direct contact to indoor air. The loading factor considered was L = 0.93 m^2/m^3.

Fig. 3 Test specimens of the watertightness and air permeability tests installed in the testing chamber: NATURLAM W180—**a** straight specimen and **b** corner specimen; **c** TFS 105

Fig. 4 Images of the impact tests

2.3 Safety in Use—Impact Resistance

The mechanical resistance against impact loads was assessed, for two TFS wall panels, according the indications given in Sect. 2.2.13 of EAD 340308-00-0203 [9]. One test specimen was concerning TFS 105 and the other concerning TFS 145. The dimensions of the test specimens were 1.25 m × 3.9 m and the maximum distance between studs was 0.55 m and 0.56 m, for TFS 105 and TFS 145, respectively. Figure 4 shows illustrative images of the impact tests. The tests consisted of verifying the serviceability impact resistance and the safety in use impact resistance, following the criteria presented in Annex C of the EAD [9]. Two impact points were analyzed for each category.

2.4 Protection Against Noise—Airborne Sound Insulation

The acoustical performance of the components was carried out in accordance with EN ISO 10140-1 [19], EN ISO 10140-2 [20], EN ISO 10140-4 [21] and EN ISO 717-1 [22]. The wall solutions of the ITS system, NATURLAM W180 Monolam and NATURLAM W180 Bilam were tested. For the TFS system, a TFS 105 wall panel was tested. The test specimens nominal dimensions were 3.14 m × 3.14 m. The test area had the standardized value of 10 m^2 (3.16 m × 3.16 m). Figure 5 shows images of the specimens installed in the acoustic testing chambers of the Itecons.

Fig. 5 Images of the test specimens installed in the acoustic testing chambers of the Itecons

2.5 *Energy Economy and Heat Retention*

Thermal Resistance

The thermal resistance of the components was determined according to EN ISO 6946 [23] and EN ISO 10211 [24], using the Bisco software from Physibel.

Air Permeability

The air permeability of the NATURLAM W180 Bilam was assessed according to EN 1026 [25]. The test specimens were composed by a log straight wall and a log corner wall (see Fig. 3). For TFS system the air permeability test was performed according to EN 12114 [26]. The test specimen was the same of the watertightness test (see Fig. 3).

3 Results

Table 1 presents the results. They show that racking and compression resistance values reflect structural performance and are useful to incorporate into structural designs. Fire reaction classification ranges from Class E to Class A1. Watertightness tests confirm waterproofing under high pressure, while the risk of condensation appears negligible. Acoustic insulation varies, reaching up to 36 dB of airborne sound reduction. Thermal resistance indicates effective heat retention, depending on material and thickness. Lastly, air permeability shows straight walls offer better airtightness than corners.

Table 1 Results obtained for ITS and TFS systems

Construction solution	ITS	TFS
BWR 1—mechanical resistance and stability		
Racking stiffness (N/mm) (mean value)	2490	1798
Racking strength (kN) (mean value)	12.45	21.08
Compression resistance	622.5 kN	–
BWR 2—safety in case of fire		
Reaction to fire	Based on the reaction to fire of the components. The worst class observed was Class E, while the best class observed was Class A1	
BWR 3—hygiene, health and the environment		
Water vapour resistance	No risk of condensation for the studied climate	
Watertightness	Classification acc. EN 12208 [27] Class E1500 (straight wall) Class E1200 (corner wall)	Classification acc. EN 12865 [17] Entirely waterproof under a max. pressure difference of 1200 Pa
Content, emission and/or release of dangerous substances	TVOC after 28 days = 258 $\mu g/m^3$ TSVOC after 28 days < 258 $\mu g/m^3$	–
BWR 4—safety and accessibility in use		
Impact resistance	–	TFS 105 and TFS 145: Pass for all impact energies tested
BWR 5—protection against noise		
Airborne sound insulation—weighted apparent sound reduction index	NATURALAM W180: Monolam: $R_w = 33$ dB | Bilam $- R_w = 31$ dB	TFS 105: $R_w = 36$ dB
BWR 6—energy efficiency, and heat retention		
Thermal resistance	NATURALAM W180: Monolam: $R_T = 3.03\ m^2K/W$ | Bilam: $R_T = 2.86\ m^2K/W$	TFS 105: $R_T =$ 2.94–3.40 m^2K/W | TFS 145: $R_T = 3.98–4.59\ m^2K/W$
Air permeability	Classification acc. EN 12207 [28] Class 4 (straight wall) Class 3 (corner wall)	Air permeability acc. EN 12114 [26] in relation with length of joint VL = 0.58 m^3/hm (Pressure = 600 Pa)

4 Conclusions

The main objective of this study was to demonstrate the crucial role that European Technical Assessments of innovative construction systems can play in the building sector, specifically in characterizing innovative timber-based construction solutions. Through the conducted work and obtained results, valuable characterizations were achieved, providing significant technical insight. The results hold even greater value as they were obtained following validated and standardized procedures. This, translates into greater confidence for Rusticasa-Construções, Lda., designers, project owners, and other construction industry stakeholders.

The study confirms that European Technical Assessments (ETAs) are an important tool that provide confidence to manufacturers on product reliability, allow for regulatory compliance, and enhances innovation in timber construction.

References

1. Fedorik F, Niemi AH (2024) Hygrothermal assessment and design models for mass timber building envelopes in northern conditions. Eng Struct 305. https://doi.org/10.1016/j.engstruct.2024.117714
2. Branco JM, Araújo JP (2012) Structural behaviour of log timber walls under lateral in-plane loads. Eng Struct 40. https://doi.org/10.1016/j.engstruct.2012.03.004
3. Duan Z, Huang Q, Zhang Q (2022) Life cycle assessment of mass timber construction: a review. Build Environ 221. https://doi.org/10.1016/j.buildenv.2022.109320
4. Gaspari A, Giongo I, Piazza M, Gaspari A, Giongo I, Piazza M (2022) A risk-based approach for timber building decay prediction ICSI 2021 the 4th international conference on structural integrity
5. Fazel A, Adel A (2024) Enhancing construction accuracy, productivity, and safety with augmented reality for timber fastening. Automat Constr 166. https://doi.org/10.1016/j.autcon.2024.105596
6. Bucci Ancapi F, Kleijweg M, Van den Berghe K, Yorke-Smith N, van Bueren E (2025) How ex ante policy evaluation supports circular city development: Amsterdam's mass timber construction policy. J Environ Manag 376. https://doi.org/10.1016/j.jenvman.2025.124516
7. Martinez RG (2017) Hygrothermal assessment of a prefabricated timber-frame construction based in hemp. Proc Environ Sci 38. https://doi.org/10.1016/j.proenv.2017.03.155
8. David MN, Miguel RS, Ignacio PZ (2024) Timber structures designed for disassembly: a cornerstone for sustainability in 21st century construction. J Build Eng 96. https://doi.org/10.1016/j.jobe.2024.110619
9. EAD_Timber_Building_Kits (2020)
10. Itecons (2022) Eta 18/0984
11. Itecons (2023) Eta 22/0889
12. European Union (2011) Construction products regulation (regulation (EU) no 305/2011
13. CEN (2011) EN 594: timber structures—test methods—racking strength and stiffness of timber frame wall panels
14. CEN (1991) EN 26891: timber structures—joints made with mechanical fasteners—general principles for the determination of strength and deformation characteristics
15. CEN (2012) EN ISO 13788: hygrothermal performance of building components and building elements—internal surface temperature to avoid critical surface humidity and interstitial condensation—calculation methods
16. CEN (2016) EN 1027: windows and doors—water tightness—test method. Brussels
17. CEN (2001) EN 12865: hygrothermal performance of building components and building elements—determination of the resistance of external wall systems to driving rain under pulsating air pressure
18. CEN (2017) EN 16516: construction products—assessment of release of dangerous substances—determination of emissions into indoor air

19. CEN (2016) EN ISO 10140-1: acoustics—laboratory measurement of sound insulation of building elements—part 1: application rules for specific products
20. CEN (2010) EN ISO 10140-2: acoustics—laboratory measurement of sound insulation of building elements—part 2: measurement of airborne sound insulation. Brussels
21. CEN (2010) EN ISO 10140-4: acoustics—laboratory measurement of sound insulation of building elements—part 4: measurement procedures and requirements. Brussels
22. CEN (2013) EN ISO 717-1: acoustics—rating of sound insulation in buildings and of building elements—part 1: airborne sound insulation
23. CEN (2017) EN ISO 6946: building components and building elements—thermal resistance and thermal transmittance—calculation methods
24. CEN (2017) EN ISO 10211: thermal bridges in building construction—heat flows and surface temperatures—general calculation methods
25. CEN (2000) EN 1026: windows and doors—air permeability—test method
26. CEN (2000) EN 12114: windows and doors—air permeability—laboratory test method for the determination of air permeability of door and window assemblies
27. CEN (2000) EN 12208: windows and doors—water tightness—classification
28. CEN (2003) EN 12207: windows and doors—air permeability—classification