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ORIGINAL PAPER

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MUSTERHOLZBAURICHTLINIE (MHolzBauRL) AS A TOOL FOR SHAPING MULTI-STOREY TIMBER BUILDINGS IN GERMANY

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ABSTRACT

Given increasingly stringent climate requirements, timber is once again emerging as a low-emission material for medium- and high-rise buildings; however, its inherent combustibility still limits widespread adoption. This paper critically analyses the MHolzBauRL – guidelines implemented in selected German *Länder* – as an integrated legal-technical instrument for designing multi-storey timber structures that meet the REI 60 and REI 90 fire-resistance classes. We outline the scope and hierarchy of the regulations, explain the principles in detail and compare them with DIN 4102. A review of completed projects reveals that the guidelines streamline approval procedures and enhance investor confidence in engineered timber. We conclude that the MHolzBauRL provides coherent and unambiguous criteria for the safe construction of tall timber buildings, and we highlight the need for broader regulatory harmonisation – including the potential adoption of similar variants in Poland.

Keywords: MHolzBauRL, timber construction, fire safety, multi-storey buildings

INTRODUCTION

In recent years, due to climate change and efforts to reduce concrete usage, timber has re-emerged as a promising material for multi-storey construction (Gustavsson & Sathre, 2011; Churkina et al., 2020). Wood's renewability and lower carbon footprint promote its application in sustainable architecture (Li, Lei, Wu & Yan, 2017). However, its inherent combustibility poses significant challenges, compounded by low awareness of fire safety solutions for timber structures and a general lack of trust in the material's performance (Zang et al., 2023). The *Musterholzbaurichtlinie* (MHolzBauRL) serves as a crucial regulatory framework in Germany, enabling the safe design and implementation of multi-storey timber buildings by addressing these fire safety concerns. This study aims to analyse the role of the MHolzBauRL in facilitating timber construction, focusing on fire protection requirements and the combustible nature of wood.

In Germany, building regulations classify structures into five categories (*Gebäudeklassen*, GK1–GK5) according to their height and occupancy, as outlined in the *Musterbauordnung* (Bauministerkonferenz, 2024a). Classes 1–3 cover low-rise buildings, where the minimum fire resistance requirement is REI 30. Class 4 applies to mid-rise buildings up to approximately 13 m, requiring REI 60 fire resistance. Class 5 includes high-rise buildings with no height limit, where REI 90 must be ensured. These classes provide the legal framework for defining fire safety objectives, evacuation times and permissible structural

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solutions. The MHolzBauRL is of particular significance because it explicitly enables combustible materials such as timber to be used for structural elements in Classes 4 and 5, provided that the assemblies meet the prescribed REI 60 or REI 90 criteria.

Wood as a response to the climate crisis

In the face of the escalating climate crisis and the urgent search for low-carbon building materials, wood is gaining renewed attention as a construction material of the future. Its low embodied carbon, ability to store carbon dioxide and renewable nature position it as one of the most promising solutions for climate--conscious architecture.

Compared to conventional building materials such as concrete or steel, wood stands out not only for its environmental performance, but also for its recyclability and biodegradability. However, the use of timber in multi-storey buildings remains limited, primarily due to concerns about fire safety and regulatory barriers (Ljunggren, Fredriksson, Johansson & Sasic Kalagasidis, 2025).

Germany has embraced a progressive and systematic approach to sustainability through *Klimaschutz*[1] (climate protection) policies. Introduced in the early 1990s and strengthened significantly with the Climate Protection Plan 2050 (*Klimaschutzplan 2050*, adopted in 2016), these strategies aim to drastically reduce greenhouse gas emissions across all sectors – including the construction industry. In this context, timber construction is actively promoted as a key measure for achieving climate targets.

In recent years, Germany has seen a surge in mid- and high-rise timber buildings, supported by public procurement policies, research programmes and a growing social awareness around sustainability. These efforts exemplify how *Klimaschutz* policies translate into practical architectural outcomes.

One of the tools for promoting timber construction in Germany is the set of guidelines called the *MHolzBauRL*, which are gradually being implemented into state law (*Landesrecht*) as 'Technical Building Regulations' (*Technische Baubestimmungen*) – a type of technical building regulation that will be discussed in more detail later in the publication.

LITERATURE REVIEW

The topic of fire-safe timber construction has attracted increasing scholarly and professional attention in recent years, particularly in the context of climate change and the sustainable transformation of the building industry (Buchanan & Abu, 2016). This literature review identifies and discusses key works that have informed the analysis presented in this study, focusing on four thematic areas: (1) sustainable construction and timber as a low-carbon material; (2) the fire behaviour of timber structures; (3) German fire safety standards; and (4) case studies of completed timber buildings.

Within the field of Timber and Sustainable Architecture (1) and the fire behaviour of timber structures, several influential researchers and institutions from Germany have significantly contributed to advancing the discourse on sustainable timber construction (Hopkin et al., 2024; Perković et al., 2024). Notable among them are S. Hofmeister, H. Kaufmann, S. Winter, A. Hafner, W. Huss, M.W. Lennartz and S. Jacob-Freitag (Lennartz & Jacob-Freitag, 2015; Huß, Kaufmann & Merz, 2019; Hofmeister, 2022; Kaufmann, Krötsch & Winter, 2024). (2) The German fire safety regulatory landscape is defined by documents such as the *Musterbauordnung* (Bauministerkonferenz, 2024a), *Musterholzbaurichtlinie* (Bauministerkonferenz,

[1] *Klimaschutz* is the German term for climate protection and, in Germany, it represents a comprehensive national strategy aimed at reducing greenhouse gas emissions, promoting sustainable development and transitioning towards a low-carbon economy. Unlike in many other countries, *Klimaschutz* in Germany is not just a political slogan – it is a legally anchored, multi-sectoral framework with concrete targets, action plans and accountability mechanisms.

2020; Bauministerkonferenz, 2021; Bauministerkonferenz, 2024b), DIN 4102[2] (Deutsches Institut für Normung [DIN], 2016) and DIN EN 13501-1 (DIN, 2019), which specify classifications for material behaviour and structural fire resistance. (3) Case studies of completed projects have been documented in architectural journals (e.g. Detail, Bauwelt, BBB) and building technology publications.

The first version of MHolzBauRL was introduced in 2004 under the title 'Model Guideline on Fire Protection Requirements for Highly Fire-Resistant Components in Timber Construction' (*Muster-Richtlinie über brandschutztechnische Anforderungen an hochfeuerhemmende Bauteile in Holzbauweise*, M-HFHHolzR). This guideline was later replaced in 2020 by the Model Timber Construction Guideline (*Muster-Holzbaurichtlinie*, MHolzBauRL). Since the adoption of the guideline, several multi-storey timber projects have been completed in Germany that illustrate its practical implementation. These include the seven-storey *Skaio* residential tower in Heilbronn (Kaden+Lager 2019), documented in detail and recognised as Germany's first official timber high-rise. Other examples are the hybrid office and conference building *Luisenblock* in Berlin (Sauerbruch Hutton 2021), the cooperative housing project *Quartier WIR* in Berlin-Weißensee (Deimel Oelschläger Architekten 2020) and the *Walden 48* apartment building in Berlin-Friedrichshain (Scharabi Architekten 2020). These projects were widely reported in Bauwelt and DBZ – not only for their architectural merit, but also because their approval processes relied on the clear and proven guidance of the MHolzBauRL. By systematically applying measures such as non-combustible cladding, cavity compartmentation and controlled service routing, these case studies demonstrate how the guideline facilitated compliance with REI 60/90 requirements in Classes 4 and 5 (O'Hegarty, Kinnane, Newell & West, 2021).

MATERIAL AND METHODS

Growing interest in medium- and high-rise timber construction in Germany collides with the need to satisfy stricter fire safety classes (REI 60/90) than those traditionally required for low-rise buildings (REI 30). This article, therefore, investigates whether the MHolzBauRL – a set of design guides introduced since 2004 – offers a sufficiently robust regulatory and technical framework for safe multi-storey timber buildings. Our inquiry combines: (i) qualitative analysis of the guideline's legal text, DIN cross-references and associated commentary; (ii) a review of national fire safety legislation and approval pathways; and (iii) case studies of completed German timber buildings erected after 2004 that apply the MHolzBauRL. Through this mixed documentary and case-based approach, we assess how the guideline translates into detailed rules, approval times and built performance. The paper maps the evolution of the regulation, benchmarks it against DIN 4102-4 (DIN, 2016) and Eurocode provisions and discusses its strengths, limitations and transferability to other jurisdictions, notably Poland.

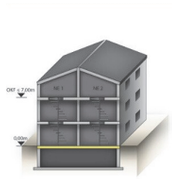
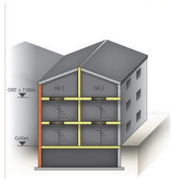
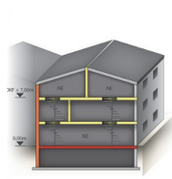
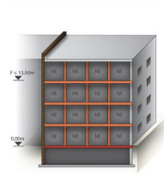
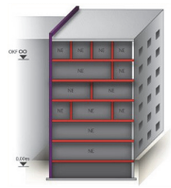
Classification of buildings in Germany according to §52

In Germany, buildings are classified into five main classes and one subclass according to §52 of the Model Building Code (MBO), primarily based on their height. This classification serves as a basis for applying specific fire protection requirements to ensure safety. The five main classes are Class 1 (GK1) through Class 5 (GK5). Each class corresponds to a required minimum fire resistance rating, expressed in terms of REI (acronym for resistance, integrity, insulation) values ranging from REI 30 to REI 90. Specifically, Classes 1 and 2 typically require lower fire resistance ratings, Class 3 (GK3) requires REI 30, Class 4 (GK4) requires

[2] DIN 4102 defines the classification of building materials and structural elements based on their fire performance properties. It specifies which materials are non-combustible, which are combustible and describes their properties related to ignition, flame spread and fire sustainment. It is useful in designing timber partitions to the REI 30 and REI 60 standards.

REI 60 and Class 5 (GK5) demands the highest fire resistance of REI 90. The maximum fire resistance requirement, REI 90, ensures the highest level of fire resistance by maintaining load-bearing capacity, fire integrity and thermal insulation for at least 90 min. This classification and its corresponding fire resistance ratings are illustrated in detail in Table 1.

Table 1. Classification of buildings in Germany according to §52 MBO, taking building height into account. Height (h) within the meaning of Sentence 1 refers to the height of the upper edge of the floor of the highest occupied room above the average ground level

GK 1a	GK 1b	GK 2	GK 3	GK 4	GK 5
					
h = 7 m	h = 7 m	h = 7 m	h = 7 m	h = 13 m	h = ∞
detached building, maximum of two dwelling units, without a basement, with up to 400 m^2 per dwelling unit	detached building, agricultural and forestry use	not detached, maximum of two dwelling units, up to 400 m^2 per dwelling unit, without a basement	special building, maximum zone 400 m^2	maximum zone 400 m^2 without a basement	maximum zone 400 m^2 without a basement

Source: own work based on the MBO and the illustrations and information compiled by Cornelia Halbach, brandschutz plus GmbH.

For this publication, buildings of Classes 1–3 are considered low-rise according to the Polish ministerial regulation on technical conditions and their location. Class 4 buildings are mid-rise, while Class 5 buildings are high-rise and tall buildings.

Timber as a structural material and fire protection challenges

Compared to reinforced concrete, masonry and steel, wood is combustible and, therefore, contributes to the fire load of a building. This, combined with its unfortunate historical reputation dating back to the Middle Ages and building regulations that have not always kept pace with modern technological solutions, has raised doubts regarding the use of wood as a structural material.

However, it is essential to emphasise that the risk of fire does not fundamentally depend on the material used in the building's structure. Experience clearly shows that the risk of fire in residential buildings is not linked to the structural materials, but rather results from defects in technical installations and human error. Structural wood, as a combustible material, does not inherently pose a fire risk or cause fire ignition.

At this point, it is crucial to distinguish between the flammability of building materials (classified according to fire behaviour classes) and the fire resistance of building elements (classified according to fire resistance ratings). The flammability of building materials significantly influences the spread of fire immediately after ignition and during its development.

The standard DIN EN 13501, applicable in Germany, classifies materials into seven categories based on their flammability: A1, A2, B, C, D, E and F. Further distinctions describe the material's behaviour in fire, specifically regarding smoke development (s1, s2, s3) and flaming droplets or particles (d0, d1, d2).

In construction, wood is typically used as solid timber, glued laminated timber (glulam) or cross-laminated timber (CLT). According to the classification mentioned above, most wood-based construction materials fall under Class D-s2, d0, meaning wood is usually combustible, has a moderate smoke development rating (s2) and does not produce flaming droplets when burning (d0). The fire performance class of wood can be improved by applying appropriate fire protection measures; however, the highest achievable classification is typically B. It must, therefore, be emphasised that wood is a combustible material, meaning it can contribute to a fire load and participate in fire development if the fire is not extinguished. This fact must be considered when designing buildings with adequate fire resistance. It should be emphasised that originally, under state (*Länder*) building regulations, the use of wood as a combustible material was not permitted. The approval of combustible materials became possible only after amendments to the regulations, and this had to be done separately for each federal state.

The primary goal of fire protection is not to eliminate the possibility of fire ignition, but to control the fire in a way that allows for the safe evacuation of occupants and effective intervention by emergency services. Therefore, buildings of a particular class are assigned specific required fire resistance periods.

In Germany, according to the *Landesbauordnung* – the technical regulations that buildings and their placement must comply with – buildings are divided into five classes. This classification is based on the height of the uppermost finished floor of a room intended for human occupancy, measured relative to the average ground level (MBO, 2024). In simplified terms, buildings up to three storeys can be constructed following DIN 4102. According to this standard, building elements are designed using predefined tables, typically achieving a fire resistance rating of up to REI 30. This excludes fire separation walls, for which exceptions are usually foreseen. Buildings in Classes 4 and 5 are more challenging as they require fire resistance ratings of REI 60 and REI 90, respectively, with evacuation times reaching up to 90 min in extreme cases.

This has its justification. According to the typical fire development curve (Fig. 1), every fire follows a distinct pattern of progression. Interestingly, a self-sustaining fire tends to start extinguishing itself after approximately 90 min, which explains the basis for the fire resistance requirements in German regulations.

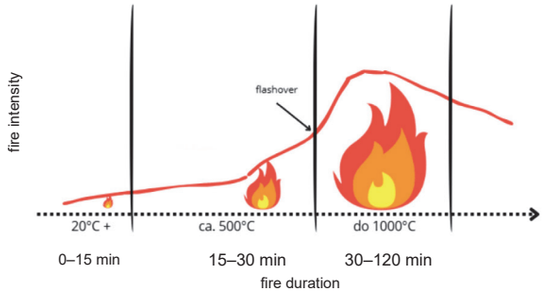


Fig. 1. Fire development diagram over time

Source: own work.

Fire safety objectives and legal framework in Germany

German regulations outline the main objectives of fire protection in buildings:

- prevent the development and spread of fire and smoke;
- enable the safe evacuation and rescue of people and animals;
- protect property;
- ensure access and effectiveness of emergency services.

To meet these goals, fire safety planning must consider factors such as fire compartment size, fire loads, evacuation routes (adapted for vulnerable users), building location and access, façade design and active fire protection systems, including alarms and sprinklers.

Ultimately, fire safety is a complex process influenced by many parameters. The choice of structural material is less important than the ability to fulfil these protection objectives; each material requires tailored strategies to achieve them.

Fire safety objectives do not exclude timber as a structural material; however, they place a responsibility on the designer to ensure that the building is planned in a way that meets fire protection goals.

RESULTS AND DISCUSSION

The MHolzBauRL: purpose and principles

The first version of *MHolzBauRL* was introduced in 2004 under the title 'Model Guideline on Fire Protection Requirements for Highly Fire-Resistant Components in Timber Construction' (*Muster-Richtlinie über brandschutztechnische Anforderungen an hochfeuerhemmende Bauteile in Holzbauweise*, M-HFHHolzR). This guideline was later replaced in 2020 by the 'Model Timber Construction Guideline' (*Muster-Holzbaurichtlinie*, MHolzBauRL). Its goal was to facilitate the construction of multi-storey timber buildings by providing explicit, standardised technical provisions that ensure fire safety compliance, especially for higher building classes requiring REI 60 and REI 90 fire resistance ratings.

Following its publication, the *MHolzBauRL* was adopted and adapted by individual German federal states (*Länder*), with varying degrees of implementation and modification reflecting regional building codes and priorities.

Several federal states have adopted the *MHolzBauRL* into their Technical Building Regulations (*Technische Baubestimmungen*), recognising the provisions of the guideline as binding and the solutions presented therein as permissible. This staggered and regionally differentiated implementation allowed for flexibility but also created a heterogeneous regulatory landscape.

The impact of introducing the *MHolzBauRL* on the German timber construction market has been significant. Since 2004, the number of multi-storey timber buildings has begun to increase, with many projects citing the guideline as essential for securing building permits and insurance. The more transparent fire safety framework has reduced planning uncertainties, accelerated approval processes and encouraged architects and developers to adopt timber in mid- and high-rise construction.

However, it is essential to identify the main challenges faced by designers who choose timber as a structural material. Unlike other building materials such as concrete and masonry, timber construction presents some unique challenges:

– As mentioned earlier, wood is a combustible material and contributes to the building's fire load;
– Timber constructions often include cavities within partitions or assemblies, which can provide pathways for fire to spread, particularly in the case of panel constructions made from solid timber and multilayer assemblies using cross-laminated timber (CLT).

Construction details by the MHolzBauRL

In response to the challenges described above, the MHolzBauRL was developed – a design guideline used in several German federal states for planning timber buildings of building Classes 4 and 5. It specifies requirements for fire resistance (REI 60 and REI 90, respectively). It provides a clear framework for the safe design of multi-storey timber structures, supporting their broader implementation in urban contexts.

The MHolzBauRL applies primarily to structures in building Classes 4 and 5, in which the load-bearing, bracing or room-enclosing structural elements are required by §26(2) Sentence 3 of the *Musterbauordnung* (MBO) to have high fire resistance (REI 60 or REI 90). The guideline allows these components, by way of exception under §26(2) Sentence 4 MBO, to be made of combustible materials such as timber.

Additionally, Section 4 of the guideline applies to walls replacing firewalls in building Class 3, as specified in §30(3) Sentence 2, No 2 MBO. It also regulates timber or timber-based external wall cladding for buildings in Classes 4 and 5, as per §28(5) Sentence 2 MBO.

Analysis of the guidelines shows that the key requirements for designing fire-safe timber architecture include:

– Using non-combustible cladding on timber structures, with the thickness of this cladding being crucial;
– Filling the structure with non-combustible materials that have a melting point above 1,000°C;
– Routing installations outside the partition area in service cavities according to MLAR and MLüAR regulations, which are beyond the scope of this study;
– Additionally, the applied claddings should be arranged in a way that hinders fire penetration into the timber structure (as demonstrated in the details in Fig. 2). Proper sealing and blocking of fire spread within the construction are also essential, and this will be further explained and illustrated with more information in the following sections.

All assemblies shown in detail are fire-resistant partitions (Fig. 2). For this reason, the structural cavities are filled with mineral wool insulation. The construction is designed so that the interior spaces are subdivided (using a colour scheme) into smaller compartments filled with non-combustible insulation with a melting point above 1,000°C. This significantly limits the potential for fire spread within the assembly. Special attention must be paid to the cladding of combustible structural elements, including proper sealing (joint treatment) and overlapping of board layers to ensure adequate protection.

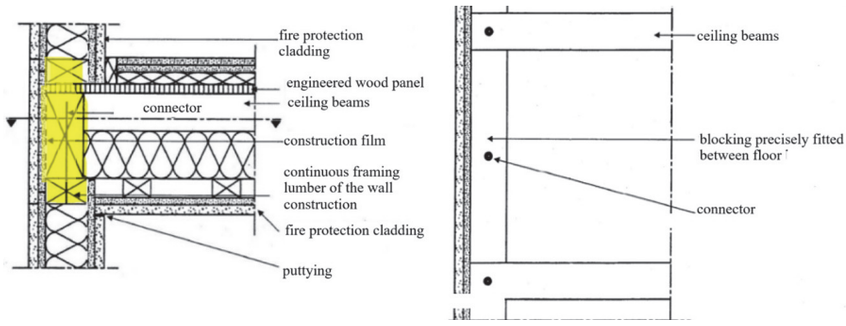


Fig. 2. Connection of ceiling to load-bearing and room-enclosing wall with fire protection cladding – e.g. stairwell or exterior wall, with the ceiling joists oriented perpendicular to the wall (left: vertical section, right: horizontal section)

Source: MHolzBauRL.

The fire-resistant wall-to-ceiling connection detail should primarily divide the partition to which the wall is attached at the junction with that wall (according to the colour coding) (Fig. 3). Next, full insulation must be provided within the wall and continuous insulation in the ceiling. The cladding should be installed with staggered joints. Attention must be paid to joint sealing as well as additional insulation in the interrupted ceiling cavity. Additionally, the non-combustible insulation layer in the floor assembly, consisting of dry screed boards, should be considered.

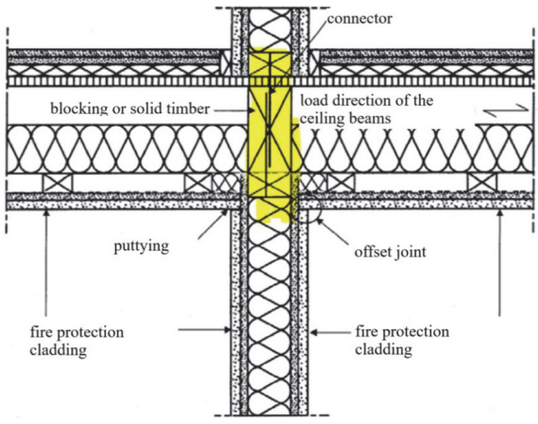


Fig. 3. Connection of load-bearing and room-enclosing wall to ceiling, with the ceiling joists oriented perpendicular to the wall (vertical section)

Source: MHolzBauRL.

The fire-resistant wall-to-ceiling connection detail should primarily divide the partition to which the wall is attached at the junction with that wall (according to the colour coding) (Fig. 4). Next, full insulation must be provided within the wall and continuous insulation in the ceiling. The cladding should be installed with staggered joints. Attention must be paid to joint sealing as well as additional insulation in the interrupted ceiling cavity. Additionally, the non-combustible insulation layer in the floor assembly, consisting of dry screed boards, should be considered.

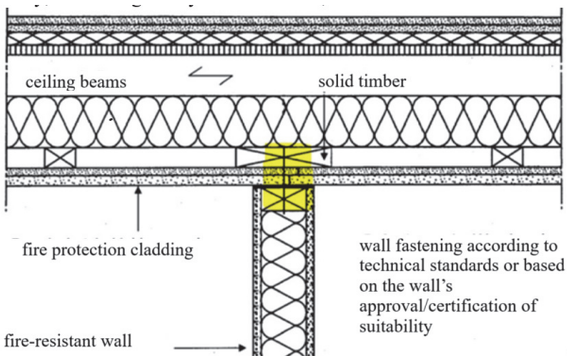


Fig. 4. Connection of load-bearing and room-enclosing wall to ceiling, with the ceiling joists oriented perpendicular to the wall (vertical section)

Source: MHolzBauRL.

In fire-resistant wall connections, it is essential to maintain the cladding layer of the building structure using an appropriate layer of boards installed with staggered joints (Fig. 5). Additionally, the cavity space within the partition must be subdivided at the junction point of the two walls.

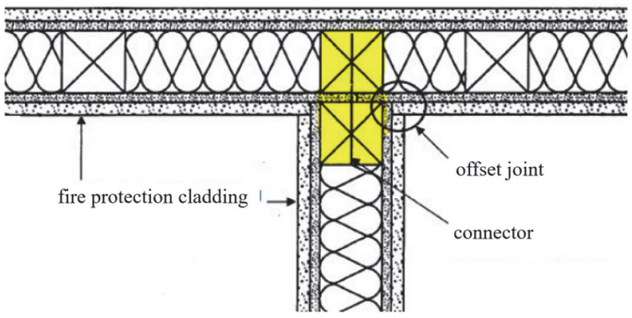


Fig. 5. Connection of a load-bearing, room-separating wall to a continuous wall with an additional stud; fire protection cladding with staggered joints (horizontal section)

Source: MHolzBauRL.

The wall connection detail can be designed in two ways while maintaining the fundamental principles set forth in the Holzbau-Richtlinie (Fig. 6). The most critical aspect remains ensuring the structure is clad with non-combustible boards of minimum required thickness, filled with appropriate insulation material and incorporating blocking of cavity spaces within the partition (marked in yellow in the colour coding). In this case, the insulation is continuous, and the junction between the perpendicular wall and the main wall is sealed with compressed insulation material.

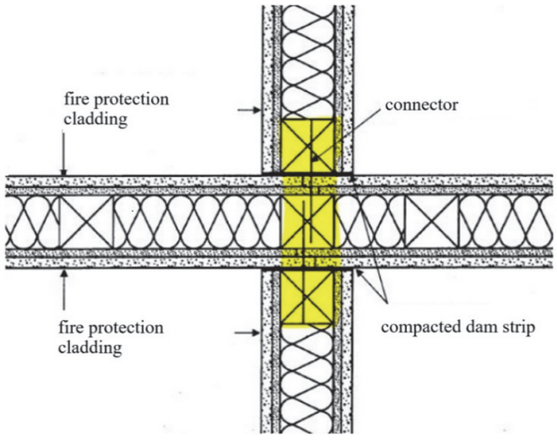


Fig. 6. Connection of load-bearing, room-separating walls to a continuous wall with an additional stud; butt joints to continuous fire protection cladding (horizontal section)

Source: MHolzBauRL.

Creating openings in walls for the installation of doors, windows or service penetrations in REI 60 and REI 90 constructions (equivalent to F60 and F90) requires internal cladding of the opening, ensuring staggered joints at corners (Fig. 7). This requirement does not apply to penetrations designed by MLAR and MLuAR regulations, which are outside the scope of this document.

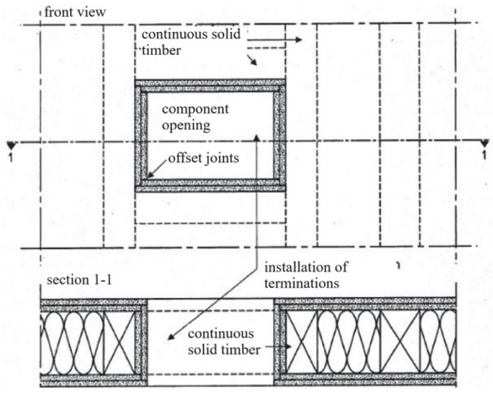


Fig. 7. Opening in the building element with fire protection cladding for the installation of doors, windows and other fittings (top image: elevation view, bottom image: horizontal section)

Source: MHolzBauRL.

Case studies: fire-resistant timber buildings in Germany (REI 90 standard)

To demonstrate the application possibilities of the MHolzBauRL, the following solutions are presented: intermediate ceilings, exterior walls and interior walls, all by the current standard DIN 4102-4. Additionally, partitions in the REI 30 standard and REI 60/90 partitions compliant with the Holzbaurichtlinie guidelines are included. It should be noted that DIN 4102-4 is used for the design of timber partitions up to a maximum REI 60 standard, with particular emphasis on partitions with REI 30 fire resistance.

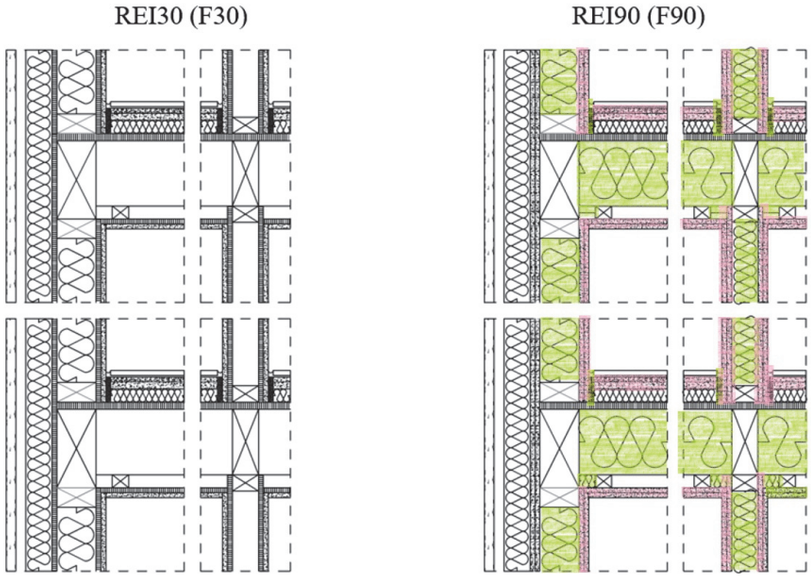


Fig. 8. Connection of the external wall to the floor/ceiling slab. Comparison of timber construction details in F30 and F90 fire resistance standards according to the MHolzBauRL

Source: own work based on DIN 4102-4 and the MHolzBauRL.

Based on the conducted case study, it can be clearly stated that the Holzbaurichtlinie, much like DIN 4102-4, provides a clear and structured set of guidelines. These define design principles and material choices for timber structures in a way that ensures compliance with fire protection objectives and formal legal requirements.

It should be noted that the main difference between the presented details lies in the modification of the cladding, which is intended to protect the structure against fire in accordance with the guidelines, ensure the continuity of the cladding, fill gaps in heterogeneous partitions and provide insulation in the partitions according to the guidelines. Corresponding changes to the structural design have been omitted in this comparison.

It should be distinguished that state (*Länder*) law is not equivalent to federal law. The so-called *Muster* regulations set a general direction and serve only as a recommendation for state-level legislation. Berlin adopted regulations allowing the use of wood as a combustible material in construction in 2018 based on an exception. In the design of such buildings, the MHolzBauRL guidelines could be used as a reference.

It should be noted that in 2018, the MHolzBauRL was not yet included in the applicable Berlin technical regulations (*Technische Baubestimmungen*) and, at that time, served only as helpful guidance, already in force in other federal states. This formal inclusion occurred only in 2025. For this reason, the authors of the study conducted a review of buildings constructed with timber structures in Classes 4 and 5 after 2018, considering the hybrid type of construction. Popular solutions to economically meet fire protection requirements were examined. The use of hybrid construction was permitted for the ground floor and circulation areas (Table 2). It is clear that such buildings are being constructed, and the changes in regulations, as well as the inclusion of the MHolzBauRL in the rules, have contributed to the emergence of timber-structured buildings in medium- and high-rise constructions in Berlin.

The overview of realised projects confirms that since the publication of the MHolzBauRL, in connection with the amendment of the MBO, the number of multi-storey timber and hybrid buildings in Berlin has grown steadily. Each of the listed facilities demonstrates how the guideline provided a transparent framework for regulatory approval. For example, the *Quartier WIR* cooperative housing complex in Weißensee (2020) shows how the guideline facilitated the planning of larger urban ensembles with multiple timber buildings under one fire safety concept. In the *Luisenblock* office and conference building (2021), the MHolzBauRL enabled the use of engineered timber in a highly visible federal project, illustrating that institutional clients were also willing to rely on timber once a codified path to compliance was available.

Residential projects such as *Walden 48* (2020) and *Mehrfamilienholzhaus Linse* (2021) reveal that private investors increasingly consider timber viable for inner-city multi-family housing once approval times are reduced and insurance premiums adjusted. Similarly, *Ausbauhaus Südkreuz* (2022) and *Stendaler Straße* (2024) demonstrate that the guideline not only supported mid- and high-rise construction in detached configurations, but also in dense infill contexts – where fire safety requirements are particularly stringent.

It is important to note that these buildings still have a hybrid character, in which the structural core is largely formed by a reinforced concrete stairwell. With the advancement of timber construction, new solutions can be expected – an example being the Walden 48 project, where elevator shafts were built from CLT panels. However, such solutions are not always necessarily the most advantageous, for instance due to structural or economic considerations.

Taken together, these examples underline that the MHolzBauRL did not introduce novel technical solutions, but rather codified accepted assemblies in a way that gave regulators, insurers and investors confidence. This translated into shorter administrative procedures – typically one-third less time compared to pre-2018 timber projects – and helped to mainstream timber as a structural option for GK4 and GK5 buildings in Berlin.

Table 2. Overview of timber or hybrid structures (allowing for reinforced concrete basements and/or ground floors as well as stairwells) commissioned between 2019 and 2024

No	Object	Location	Planner	Completion year	Structural system	Building category accord. MBO
1	Urbaner Holzbau residential building	Berlin--Adlershof	Kaden+Lager	2019	hybrid construction / / detached buildings	GK5
2	Projekt P1 residential building	Berlin--Prenzlauer Berg	Kaden Klingbeil Architekten / / Kaden _Lager	2019	hybrid construction / / detached building	GK5
3	Quartier WIR residential estate	Berlin--Weissensee	Deimel Oelschläger Architekten	2020	hybrid construction / / detached buildings	GK5
4	Luisenblock Deutscher Bundestag, office and conference building	Berlin--Mitte	Sauerbruch Hutton in coorporation with Kaufmann Bausysteme	2021	hybrid construction / / detached building	GK5
5	Walden 48 residential building	Berlin--Friedrichshain	Scharabi	2020	hybrid construction / / detached building	GK5
6	Mehrfamilienholzhaus Linse building – residential with supporting facilities	Berlin--Schöneberg	Scharabi Architekten / / Praeger Richter Architekten	2021	hybrid construction / / infill building	GK5
7	Kudamm 210 hotel extension	Berlin--Charlottenburg	JWA + Ralf Wilkening Architect	2022	hybrid construction / / infill building	GK5
8	Ausbauhaus Südkreuz residential building	Berlin--Schöneberg	Praeger Richter Architekten	2022	hybrid construction / / detached building	GK5
9	Stendaler Straße residential with supporting facilities	Berlin--Moabit	AHM Architekten	2024	hybrid construction / / detached building	GK5
10	Haus im Park nursing home	Berlin--Pankow	Modersohn & Freiesleben Architekten Partnerschaft	2024	hybrid construction / / detached building	GK4

Source: own work.

CONCLUSIONS

This study aimed to determine whether the MHolzBauRL provides a robust, practical and scalable framework for the fire-safe realisation of multi-storey timber buildings in Germany. The doctrinal review, comparison with DIN 4102-4 and analysis of built projects demonstrate that the guideline effectively translates the generic REI 60/90 requirements of the *Musterbauordnung* into a coherent design logic that can be implemented without requiring full-scale fire tests. Its prescriptive hierarchy – non-combustible claddings, cavity compartmentation and controlled service routing – effectively bridges the long-standing regulatory gap between low-rise timber prescriptions and the performance-based approvals required for taller structures.

Projects completed since 2015 indicate that citing the MHolzBauRL in the fire safety concept typically shortens permitting procedures and could remove the insurance surcharges that burdened earlier timber developments,

suggesting that legal clarity rather than technical novelty is now the primary driver of investor confidence. Yet, the guideline's voluntary, state-by-state adoption has produced a patchwork of editions and effective dates that complicate cross-regional procurement and hinder consistent performance monitoring. Federal consolidation – ideally through incorporation into the forthcoming DIN EN 1995-1-2/NA – would amplify the MHolzBauRL's impact and facilitate systematic data collection. A similar process could be implemented in Poland, provided that combustible load-bearing elements in medium- and high-rise buildings are clearly identified, a nationally agreed catalogue of prefabricated assemblies is created and mechanisms for updating the catalogue are established as testing methods and products evolve. Two research needs remain pressing: long-term monitoring of in-service fire incidents to verify assumptions about charring and compartment integrity, as well as integrating life-cycle carbon metrics into fire safety decision-making to balance climate and safety objectives transparently. Overall, the MHolzBauRL demonstrates that concise, assembly-based fire regulations can coexist with innovation and decarbonisation goals when they are embedded in a clear approval pathway; consolidating the guideline at federal level and encouraging its adaptation in neighbouring countries would be decisive steps towards mainstreaming tall timber construction across Europe.

Authors' contributions

Conceptualisation: K.K. and A.S.; methodology: K.K. and A.S.; validation: A.S.; formal analysis: K.K. and A.S.; investigation: K.K.; data curation: K.K.; writing – original draft preparation: K.K.; writing – review and editing: K.K. and A.S.; visualisation: K.K.; supervision: A.S.; project administration: A.S.

All authors have read and agreed to the published version of the manuscript.

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MUSTERHOLZBAURICHTLINIE (MHOLZBAURL) JAKO NARZĘDZIE KSZTAŁTOWANIA WIELOKONDYGNACYJNYCH BUDYNKÓW DREWNIANYCH W NIEMCZECH

STRESZCZENIE

Wobec rosnących wymagań klimatycznych drewno ponownie zyskuje rangę niskoemisyjnego materiału konstrukcyjnego do wykorzystania w budownictwie obiektów średnio- i wielokondygnacyjnych, lecz jego podatność na zapalenie wciąż ogranicza zastosowanie. Artykuł poddaje krytycznej analizie MHolzBauRL – wytyczne wdrożone w wybranych krajach związkowych Niemiec – jako zintegrowane narzędzie prawno-techniczne umożliwiające projektowanie wielokondygnacyjnych konstrukcji drewnianych w klasach odporności ogniowej REI 60 i REI 90. W artykule omówiono zakres i hierarchię regulacji, zasady detalowania (niepalne okładziny, przegrody pożarowe, prowadzenie instalacji) oraz porównano je z niemiecką normą DIN 4102-4. Dzięki studium zrealizowanych obiektów budowlanych potwierdzono, że przyjęcie wytycznych skraca procedury administracyjne i zwiększa zaufanie inwestorów do konstrukcji z drewna inżynierskiego. Wnioskujemy, że MHolzBauRL dostarcza spójnych, jednoznacznych kryteriów bezpiecznego wznoszenia budynków drewnianych o dużej liczbie kondygnacji, a ponadto identyfikujemy potrzebę szerszej harmonizacji przepisów, w tym potencjalnego wdrożenia analogicznych rozwiązań w Polsce.

Słowa kluczowe: MHolzBauRL, budownictwo drewniane, bezpieczeństwo pożarowe, budynki wielokondygnacyjne