



# Fire safety regulations in Brazil: Analysis of the occupancy classification of buildings

Bernardete de Lourdes Ferreira Minervino<sup>1</sup> · Cristina Calmeiro dos Santos<sup>2</sup> · Paulo Gustavo von Krüger<sup>3</sup> · João Paulo C. Rodrigues<sup>1</sup>

Received: 6 December 2023 / Accepted: 3 January 2025 / Published online: 17 February 2025  
© The Author(s) 2025

## Abstract

Fire safety in a building depends on several factors, including its use and occupancy, which fire protection systems are present in the building and the state of maintenance of these systems. Considering the fact that Brazil has 27 federal states and each of them has its own fire safety legislation, it is common for there to be divergences that result in different protection requirements depending on the state where the building is located. This study analyzes Brazilian state fire safety legislation with regard to the sizing of fire protection systems for buildings, considering the parameters used for such sizing. It then identifies the differences in classification in terms of the use and occupation of buildings in the 27 federal states; and presents a proposal for a standardized classification for the whole country, taking into account the convergences that already exist in state legislation. The main objective is to suggest a discussion starter for the process of standardizing fire safety parameters in Brazil.

**Keywords** Building classification · Legislation · Fire safety · Standardisation of legislation · Use and occupation of buildings

## Introduction

Given the variety of fire safety legislation applied in Brazil, it is common to find differences in the parameters determined in each of the 27 states of the federation. The differences range from the classification code to the values adopted such as parameters for sizing systems, and even the way in which the process of constructing or adapting a building is carried out.

Drawing up a fire safety project is already an activity that requires considering a huge range of regulatory and functional characteristics. Drawing up this type of project for buildings located in different states of the federation is an even more complex task since safety parameters and requirements change from state to state.

The reason for the differences between state laws has more to do with administrative aspects than with the technical aspects that these laws deal with. The laws from the 27 Brazilian states differ in terms of the size of the systems required for a fire project and the criteria used to select these systems in each building. One of the reasons for this is the different classification of buildings in terms of their use and occupation.

After analyzing the differences in use and occupancy, this study presents a table of suggestions for standardizing this classification throughout the country. The idea of unifying the use classification of buildings could be the start of a process to standardize fire safety legislation in Brazil and make it simpler to define protection systems in fire projects throughout the country.

## On fire safety legislation

Fire Safety (FS) is a combination of preventive and combative actions and resources that aim to prevent a fire situation, control the situation (should it occur), provide for the safe evacuation of people from the fire to a safe place, and guarantee access for rescue and assistance teams [1]. The importance of FS for protecting lives and property is common

✉ Bernardete de Lourdes Ferreira Minervino  
bernardete.minervino@gmail.com

<sup>1</sup> Department of Civil Engineering, University of Coimbra, Coimbra, Portugal

<sup>2</sup> School of Civil Engineering, Polytechnic Institute of Castelo Branco, Castelo Branco, Portugal

<sup>3</sup> Department of Architecture, Urbanism and Design Technology, University of Minas Gerais, Belo Horizonte, Brazil

sense, although its applicability is subject to wide-ranging discussions, different interpretations and disagreements as to its applicability and responsibility.

Around the world, the issue of fire safety is dealt with in different ways, depending on the jurisdiction applied. The approach of the authorities in each location, the requirements for achieving a minimum standard of fire safety in buildings and even the mandatory protection systems can vary from one country to another, or even between districts within the same country.

## FS legislation at international level

### In the United States of America

In the United States of America, legislation is decentralized and each state can implement its own regulations to deal with fire safety. The National Fire Protection Association (NFPA) is the central body that defines safety systems and general standards, publishing standards in a wide variety of areas related to the safety of people and buildings in fire situations. NFPA standards are not mandatory and do not have the force of law, although most states choose to adopt or modify their codes directly for use in local buildings [2]

### In the United Kingdom

In the UK, the legislation of the member countries (England, Scotland, Wales and Northern Ireland) is consistent with each other. There are three levels of legislation: laws (which must be passed by parliament), technical regulations (which are more specific and technical and are drawn up by government agencies) and technical standards (which are drawn up by the British Standardization Association). Laws and technical regulations are mandatory and technical standards are recommended for implementation, but not mandatory [3].

### In China

In China, fire safety legislation is also drawn up and applied at different hierarchical levels in each location. There are different laws, regulations, protection rules and normative documents throughout the country. And there is also the aggravating situation that many related issues are dealt with in different legislation in different ways. The Ministry of Housing and Urban–Rural Development has been working to create centralized fire safety legislation, proposing baseline control requirements to ensure the quality and safety of projects and replacing the scattered mandatory provisions in the current standard system. [3]

### In the European Union

The reality in the European Union (EU) already shows progress in the unification of standards to facilitate both the regulation and

execution of fire safety. Since the European Union was founded, its member countries have understood that the standardisation of technical matters facilitates the application and execution of projects between countries, as well as boosting scientific research, making it possible to study in several countries following the same parameters. Therefore, although each country has its own fire safety legislation, they all use the same parameters to classify buildings and size protection systems.

### In Portugal

Moving towards the standardising of fire safety standards, Portugal implemented the Decree-Law 220/2008 [4] in 2008. This Decree-Law brought together terms, characteristics and technical requirements that had previously been dispersed into separate and often divergent standards. In addition, the National Civil Protection Service was created in 2003 to help coordinate the organisations involved in rescue operations. Centralising the organisation of the bodies involved in emergency and disaster response facilitated the standardisation process that culminated in the Decree-Law 220/2008 [4].

Currently, the National Emergency and Civil Protection Authority is the body responsible for “protecting and assisting populations in the event of an emergency, serious accident or catastrophe, through prevention, response, support or recovery actions”, including the standardization of fire safety in Portugal. Other European countries are also moving towards standardising parameters. Portugal is following the trend of other European Union countries by standardising its legislation and harmonising the parameters with those already applied in other countries.

### FS legislation in Brazil

Although there are records of brief legislation on fire safety in Brazil as far back as the nineteenth century, these were too vague and only aimed to extinguish the fire once it had been detected [5]. It was only in the 1970s that more specific legislation on fire safety began to emerge [6]. Although vague, these laws were already geared towards flame control devices and facilitating the escape of building occupants.

More specific standards, defining technical criteria for implementing systems and sizing aimed at each type of building, only began to be approved in Brazil in the second half of the 20<sup>th</sup> century. This is because there was no popular appeal to instigate legislators in this direction, until major fires occurred that were highlighted in the press and showed the urgent need to prevent such tragedies. "The absence of major fires that resulted in considerable losses, whether in terms of property or the number of lives lost, did not favour, at least until the early 1970s, a relevant discussion on the subject in the country. [7]

In Brazil, the power to legislate follows a hierarchy defined by the 1988 Federal Constitution. If the Federal Government fails to draw up a law regulating a particular

subject, the states of the federation have the power to legislate on that subject, to the extent that their respective legislative assemblies deem pertinent. This fact is established in §3 of Article 24: "In the absence of a federal law on general norms, the states shall exercise full legislative competence to meet their peculiarities" [8]. Various issues that require regulation and standardisation are dealt with at a state level in compliance with this article. However, this ends up generating significant differences between states when it comes to dealing with the same subject, as is the case of fire safety.

Considering the function defined by Article 144 of the Federal Constitution, all states have laws that determine the competences of fire services to draw up regulations and technical standards on fire safety, following the objectives of saving lives and safeguarding property, in this order of priority. "Public security, the duty of the state, the right and responsibility of all, is exercised for the preservation of public order and the safety of people and property, through the following bodies: [...] V—Military police and military fire brigades." [8]

Being a country of continental dimensions, divided into a large number of federal units that have autonomy to legislate on fire safety, many discrepancies are found between these laws, without there being a technical reason to justify such differences, except for the factor of autonomy of state legislative competence.

The fire safety regulations and technical standards drawn up and applied in each state differ not only in the definitions of technical parameters but also in the scope of each state standard and in the competencies attributed to each fire department.

Analysing this aspect, Rodrigues [9] states that, in compliance with §5 of Article 144 of the Federal Constitution, "military fire brigades, in addition to the duties defined by law, are responsible for carrying out civil defense activities" [8], there is a need for the federal states to take on the role of legislating more specifically on FS. The author emphasizes that "the

State Constitutions and the respective State Basic Organization Laws (LOB) have defined competence for fire and panic safety in buildings to the Military Fire Brigades with different scope, from attributions limited to analysis, inspection and licensing, to the additional possibility of regulating, researching and investigating fires". [9]

Because of this autonomy, the ways in which technical information is drawn up and presented in the 27 states of the federation differ. In like manner, the procedures for approving fire projects, the representation of technical information, the sizing of FS systems and, most seriously, the parameters that determine minimum safety conditions also differ.

There is also the observation that the updating of state technical standards depends very much on the organisational structure of each fire department. There are states that constantly revise their legislation and others that have it quite outdated [9]. The author also states that "designers and entrepreneurs should always check the regulations in force in each state very carefully, as they will have to design buildings based on archaic dictates, [...] as well as comply with current regulations, which deal with the same subject, the building installation of fire safety systems. This discrepancy undoubtedly burdens society and makes the technical credibility of what is being demanded questionable." [9]

Of Brazil's 27 federal states, only 13 have updated their respective fire safety system sizing standards in the last four years (between 2020 and 2023). There is also a difference in the type of legislation used to design these same fire safety systems. While some states already use technical standards drawn up and approved by the fire departments, others still maintain this sizing linked to laws and decrees, which go through much more bureaucracy to be amended.

Table 1 shows the year in which the legislation on the sizing of fire safety systems was last updated in each state of the Brazilian federation [10–36]:

**Table 1** Year of approval/update of each state legislation regarding the sizing of fire safety systems for buildings

Federal Unit	Legislation	Year	Federal Unit	Legislation	Year
AC	Technical Standard 01	2022	PB	Technical Standard 04	2013
AL	Technical Instruction 01	2021	PR	Law no. 4.335	2013
AP	Technical Standard 02	2020	PE	Decree no. 53.308	2022
AM	Decree no. 24.054	2004	PI	Decree no. 17.688	2018
BA	Decree no. 16.302	2015	RJ	Decree no. 42	2018
CE	Technical Standard 01	2008	RN	Technical Instruction 01	2022
DF	Technical Standard 01	2016	RS	Decree no. 51.803	2014
ES	Decree no. 2423-R	2009	RO	Technical Instruction 01	2022
GO	Technical Standard 01	2020	RR	Complementary Law no. 82	2004
MA	Technical Standard 01	2021	SC	Normative Instruction no. 01	2022
MT	Technical Standard 01	2020	SP	Decree no. 3.911	2018
MS	Law no. 4.335	2013	SE	Technical Instruction 01	2021
MG	Decree no. 47.998	2020	TO	Technical Standard 01	2022
PA	Technical Instruction 01	2019			

It is noticeable, when comparing the publication dates of state legislation, that some states have been using the same legislation for almost 20 years, despite all the technological advances that have taken place over the last two decades in the field of fire safety and prevention.

Access to these standards also varies from state to state. Some states present all FS system sizing parameters in a single document. Others have the parameters scattered in two or more documents that need to be consulted together for correct sizing.

The legislation of the state of São Paulo is used as a reference for most of the other states in the federation, which makes it easier to update, since when São Paulo updates its regulations, the other states do the same as a result.

### The first step towards standardisation

In 2017, Federal Law 13.425 [610, popularly known as the 'Kiss Law', came into force. This law was a response by the federal legislature to the various questions raised about fire safety following the fire at the Kiss nightclub in the city of Santa Maria/RS on 27 January 2013. After the fire, which killed 242 people, there was a national uproar and a call for stricter fire safety requirements and more stringent inspections of establishments intended for public gathering [37]. Society was clamouring for another tragedy like this never to happen again.

However, the Kiss Law is not very comprehensive when it comes to the technical issues that permeate fire safety. The main points covered by this law are highlighted below:

- The functions inherent to military fire brigades were listed: to plan, analyse, assess, inspect, approve and supervise fire and disaster prevention and operational activities in establishments, buildings and public gathering areas (Art. 3);
- It established the responsibility of the public authorities and military fire brigades to carry out periodic inspections and inspections of commercial and service establishments and multi-family residential buildings (Art. 5);
- It was established that undergraduate courses in Engineering and Architecture in operation in Brazil, at public and private universities and educational organisations, as well as related technology and high school courses, should include content relating to prevention fire and disasters and operational activities in their respective curricula, within a maximum of six months (Art. 8);
- It was established that information on fires that occurred in Brazil in urban areas should be gathered in a unified information system, with the participation of the Union, the States, the Federal District and the Municipalities, integrated into the disaster information and monitoring system (Art. 15).

Although the law seems strategically comprehensive, it has had no significant practical effect. Military fire brigades have

continued with the functions that were already provided for in the state's FS legislation; and undergraduate engineering and architecture courses have not adapted their curricula to the provisions of the law; and an integrated information bank on fire incidents in urban areas has so far not been created.

In addition to non-compliance, there was also, especially in Rio Grande do Sul, the site of the tragedy that gave rise to the Kiss Law, a series of "relaxations" in both the safety requirements and the deadlines for implementing and monitoring them. All of this ended up reversing or preventing any practical progress intended by the law's authors.

Although it was not effective, the Kiss Law showed an inclination to see the standardisation of requirements and the centralisation of information as a natural way to optimise the application, execution and supervision of fire safety regulations.

### Parameters used in the dimensioning of FS

By analyzing the legislation listed in Table 1, which establishes the parameters for requiring fire safety systems in the 27 Brazilian states, it is possible to see that sizing is based on four main parameters present in the building: occupancy, total area, height and initial risk. It is on the basis of these four parameters, and the relationship between them, that the systems required in each building are defined, as well as their scope and capacity. The first step is to determine the occupancy of the building. Once this information is available, the parameters of maximum height, total building area and initial risk are analysed to finally define which systems are required. The difference between the limits of these parameters is one of the main points of divergence between state legislations.

### Classification by occupation

Occupation is the first parameter to be analysed and already shows significant differences between state legislations. Generally speaking, this classification has fourteen main categories, each with subcategories that may vary from one federal state to another. They are:

- 1) Residential;
- 2) Hosting;
- 3) Commercial;
- 4) Professional services;
- 5) Educational and physical culture;
- 6) Public meeting places;
- 7) Automotive services;
- 8) Health and institutional services;
- 9) Industry;
- 10) Warehouse;
- 11) Energy;

- 12) Explosive;
- 13) Special;
- 14) Primary Sector.

In the first twelve categories, there is convergence in the classifications of the different states of the federation. Although the codes may be different in the subcategories, it is possible to identify similarities in these classifications. The thirteenth category is the 'Special' category, which classifies various occupations that do not fit into the first twelve, and where the highest rate of divergence between state regulations is found. Between states, both the scope of the subcategory and the codes used can be different, which causes divergence in classification. In three states (Acre, Goiás and Rondônia) there is also a fourteenth category called 'Primary Sector', which includes three subcategories (agriculture, zootechnics and mining). A breakdown of the classifications currently used by each state is presented later, in Table 2 in subtitle 4 of this paper.

### Height classification

Height is the second parameter to be analysed when sizing the FS systems to be required in a building. For this analysis, it is important to emphasise that height, for the purposes of sizing systems, is defined as "the measurement in metres between the point that characterises the outlet at the discharge level, under the projection of the external wall of the building, and the floor of the top floor." [1]

In order to use the height of the building as a parameter, state laws consider a minimum height (in metres) from which FS systems start to be required. In 24 states (89 per cent of the total), six height ranges are considered, as follows:

- 1) Ground floor only;
- 2) height  $\leq 6,00$  m;
- 3)  $6,00$  m < height  $\leq 12,00$  m;
- 4)  $12,00$  m < height  $\leq 23,00$  m;
- 5)  $23,00$  m < height  $\leq 30,00$  m;
- 6) height above  $30,00$  m.

With each new height range, the number or extent of FS systems required for the building increases. The most marked differences occur in some states, as explained below:

- In the Federal District (DF), there are four height bands for underground floors and eight height bands for above-ground floors. Variations occur every three metres up to 15 m, in addition to the 30 and 60 m bands;

- The state of Pernambuco (PE) considers six height ranges for sizing FS systems: 6 m, 8 m, 9 m, 12 m, 14 m and 20 m;
- The state of Mato Grosso do Sul (MS) uses a height of 10 m, determining different systems for buildings above and below this height;
- The state of Rio de Janeiro (RJ) also uses only one band, determining different systems for buildings with up to 2 floors or more than 2 floors.

It can be seen that there are significant differences between the criteria used as limits in the different legislations. However, there is no justification for these differences. No standard gives a reason for setting the limit criteria for the height bands, or a basis for choosing the number.

### Area classification

Twenty of the 27 federal states (74 per cent of the total) use the  $750\text{m}^2$  area limit for sizing systems, considering requirements for buildings with a smaller or larger total area than this predetermined limit. Another seven states use different marks or use  $750\text{m}^2$  as the initial limit, and add other areas that may determine whether or not a particular system is required.

The most noticeable dilemma in marking fixed areas that determine whether or not a system is required is the fact that there is no clear basis for such a definition. It is not clear how the understanding came about that  $750\text{m}^2$  is the ideal area to determine whether or not a system is required. There is no specific study, aimed at testing or simulating different areas, which provides a theoretical basis for setting the limit range at  $750\text{m}^2$ , instead of  $700\text{m}^2$  or  $800\text{m}^2$ , for example. The rules that diverge and use other areas as determining parameters do so based on equally unjustified precepts.

### Classification regarding initial risk

Of the 27 federal states, 21 (78 per cent of the total) use risk classification based exclusively on the fire load present in the building. In these cases, the fire load is determined by tables provided in the legislation itself, focusing on the material stored or the purpose of the building. In these cases, the classification is made in three bands (low risk, medium risk and high risk). Only six states use a different classification:

- The Federal District (DF) and Paraíba (PB) use a classification with five risk bands based on the purpose of the building (A, B-1, B-2, C-1 and C-2);
- The state of Minas Gerais (MG) uses a three-tier classification based on the use and total area of the build-

ing, with different parameters to the other federal states (Level 1, Level 2 and Level 3);

- The state of Pará (PA) uses the same three-tier classification as most other states but links it to the maximum number of people in the building to determine the initial risk level.
- The state of Rio de Janeiro (RJ) uses a four-band classification (low risk, medium risk 1, medium risk 2 and high risk), with different parameters to the other states. The limits between the classification bands are set at 1000 MJ/m<sup>2</sup> and 1200 MJ/m<sup>2</sup>. Low risk is determined by the occupancy of the building, without considering the fire load present on site.
- The state of Santa Catarina (SC) uses a four-band classification (negligible risk, small risk, medium risk and high risk). The limits between the classification bands are set at 100 MJ/m<sup>2</sup>, 300 MJ/m<sup>2</sup>, 1000 MJ/m<sup>2</sup> and 1200 MJ/m<sup>2</sup>.

In the case of defining the initial risk of the building, in addition to the fact that the differences between the parameters are very marked and there is no justification for this, there is also a debate about the effectiveness of this type of classification.

The fire load alone, although it has a great influence on the development of a fire and the release of heat flow, is not enough to determine an initial risk. Although it is a deterministic criterion that is easy to apply in technical standards, its use as the sole criterion for determining initial risk is not a consensus among experts in the field.

Some states already show variations, taking destination into account. But this alone is not a determining factor in a fire. There may be several other parameters that can have an even greater impact on the start of a fire or its development. "[...] recently there has been greater concern that it is not only the fire load that defines the severity of a fire, but also the survival conditions of people in spaces with a large concentration of people." [5] (p.235).

## Classification of buildings according to occupancy

The classification of buildings in terms of occupation is the initial criterion analysed for the sizing of FS systems. There are various sources for classifying activities, from economic activity legislation to tax legislation. [8]

Fire safety legislation has merely absorbed existing classifications with a view of risk focused on the start and development of the fire. Some fire safety legislation also considers the characteristics of the population occupying the building such as movement conditions and people's alertness. This empirical adaptation is present in all

legislation that determines the classification of buildings according to their use in main categories, as discussed in [Classification by occupation](#). Table 2 provides a more detailed overview of the parameters used in state legislation to classify destination. The main categories and subcategories accepted in each state's legislation are identified. The last column shows the percentage of federal states that adopt the subcategories mentioned.

Of the 27 federal states considered, two were not covered in the table above. The Federal District uses different nomenclatures, although the basis of the classification is very similar to the other states. The state of Pernambuco adopts only the main categories to classify buildings as to their destination, without taking into account any of the subcategories considered in other states of the federation.

It can be seen that in nine categories (residential, hosting, commercial, professional services, education and physical culture, health and institutional services, industry, warehouse and explosives) at least 23 states (85% of the total) use an identical destination classification.

In seven categories (residential, commercial, professional services, educational and physical culture, public meeting places, automotive service and health and institutional services) there were differences in the number of subcategories and in the nomenclature of some of them. One category (energy) identified by the code K only exists in the legislation of six states. In the specific case of the state of Santa Catarina, there are two subcategories for this main category.

The 'Special' category is the only one with considerable differences, which will be detailed below:

- 1) Tunnel;
- 2) Flammable and combustible liquids or gases / Tanks or tank farms;
- 3) Central communication centre;
- 4) Construction sites / Property in transformation;
- 5) Silos;
- 6) Vegetation;
- 7) Container yard;
- 8) LPG retail outlets risk I;
- 9) LPG retail outlets risk II;
- 10) Underground mines;
- 11) Agricultural activities and Potteries;
- 12) Mobile phone towers;
- 13) Transport and navigation and
- 14) Waste.

The 'Primary Sector' category is identical in the three states in which it is adopted: 1) Agriculture; 2) Zootechnics and 3) Mining.

A comparison of the legislation shows that there are more convergences than divergences between the rules. This

**Table 2** Categories and subcategories for classifying buildings according to occupation

Principal	Subcategorias adotadas pelos estados federativos		Total
Residential	A-1 A-2 A-3		89%
	Adopted by 24 states	A-4 A-5 A-6	4%
	Adopted just in RJ		93%
Hosting	B-1 B-2		89%
	Adopted by 25 states	C-4	4%
Commercial	C-1 C-2 C-3		85%
	Adopted by 24 states	D-5	7%
Professional services	Adopted just in RJ		4%
	D-1 D-2 D-3 D-4		85%
Education and physical culture	Adopted in RJ and RS		4%
	E-1 E-2 E-3	E-4 E-5 E-6	89%
Public meeting places	Adopted just in RJ		37%
	Adopted by 24 states	F-7 F-8 F-9 F-10	52%
Automotive services	F-1 F-2 F-3 F-4		4%
	Adopted by 10 states	F-11 Adopted by 14 states F-12	4%
Health and institutional services	Adopted just in RS		4%
	G-1 G-2 G-3 G-4	G-5	59%
Health and institutional services	Adopted just in RJ		30%
	H-1 H-2 H-3 H-4	Adopted by 16 states	Adopted by 8 states
Health and institutional services	Adopted just in RJ		4%
	H-5	H-6	4%
Health and institutional services	Adopted just in RJ		85%
	H-5	Adopted by 23 states	

**Table 2** (continued)

Principal	Subcategorias adotadas pelos estados federativos												Total			
Industry	I-1	I-2	I-3											89%		
Warehouse	Adopted by 25 states			J-1	J-2	J-3	J-4							89%		
Explosive	Adopted by 25 states			L-1	L-2	L-3								89%		
Special	M-1	M-2	M-3	M-4										52%		
Primary sector	Adopted by 14 states							M-5	M-6	M-7	M-8	M-9	M-10	M-11	M-12	11%

\* The other states, in addition to the varied number of subcategories, still have different definitions for each one, based on the local reality

facilitates a possible standardisation of the classification parameters, once there are no questions about their validity or effectiveness.

### Standardised classification proposal

Table 3 summarises the proposal to standardise the categories and subcategories for classifying buildings according to their use, as suggested by this study. This table organises the existing classifications in the various state legislations in force, harmonising their converging points. The divergent points are adopted in the 'Special' category so that they can be provided for in all state legislation.

The occupation categories and subcategories suggested in Table 3 are the product of a comparative study between the standards of the 27 Brazilian states, considering the merit of the classification, its constancy and its classification standards in the different legislations. The proposal includes recurring occupations in the states and/or those that deserve special attention when sizing systems, with their requirements linked to specific standards indicated by each state's sizing legislation. [9–32, 37–39].

The main categories are identified by letter and the subcategory by number, forming a single classification code: A: Residential; B: Hosting; C: Commercial; D: Professional services; E: Education and physical culture; F: Public meeting places; G: Garage; H: Health and institutional services; I: Industry; J: Warehouse; L: Explosive; M: Special and N: Primary Sector.

The fourth column, where examples of each subcategory are presented, can be used both to help the standard user understand the practical effects of the classification and to resolve doubts regarding more complex classifications. If the analyst is unable to classify the building being analyzed accurately, according to the examples in Table 3, a similarity classification must be carried out.

The main categories and subcategories, even if not currently adopted by states, may be included in their legislation for future use. There are no impediments to the classification adopted in one state being used by others, as demonstrated by the convergences shown throughout this study.

### Final considerations

The standardization of deterministic parameters of fire safety legislation is a necessity. No plausible justification was detected for differences between system classification and sizing parameters since the objectives of these standards are convergent. Classification by destination, as it is the first parameter to be analyzed, should also be the first parameter

**Table 3** Proposal to standardise the classification of buildings by occupation

Main Category	Code	Sub-category	Description and examples
Residential	A-1	Single-family homes	Condominiums of single-storey or detached houses and similar
	A-2	Multi-family housing	Condominiums of single-storey or semi-detached houses, flat blocks in general and vertical condominiums and similar
	A-3	Collective housing	Hostels, boarding schools, lodgings, monasteries, convents, geriatric residences. All with a maximum capacity of 16 beds and similar
	A-4	Private single-family residential grouping	A group of two or more private single-family residential buildings on a plot of land
	A-5	Private multi-family residential complex	A group of two or more private multi-family residential buildings on a plot of land
	A-6	Private residential grouping	Building made up of private residential units (flats) and autonomous units intended for commercial space (shops or rooms)
Hosting	B-1	Hotels	Hotels, motels, B&Bs, inns, hostels, guesthouses and A-3 divisions with more than 16 beds and similar
	B-2	Residential hotels	Hotels and similar facilities with their own kitchen in the apartments (including apartment hotels, flats, residential hotels) and similar facilities
Commercial	C-1	Small trade	Haberdashery, metal items, crockery, hospital items and others
	C-2	Medium-sized commerce	Department store buildings, department stores, shopping galleries, supermarkets in general, markets and others
	C-3	Shoppings centers	General shopping center, permanent fairs, shopping centers and others
	C-4	Kiosks	Point of sale located in a shopping center and shopping centers in general
Professional services	D-1	Location for providing professional services or conducting business	Administrative or technical offices, financial institutions (not included in D-2), notary offices, hairdressers, professional centers and similar. Public offices (Executive, Legislative and Judiciary buildings) and similar
	D-2	Bank branch	Bank branches and similar
	D-3	Repair services (except those classified as G-4)	Laundry, technical assistance, repair and maintenance of household appliances, keychains, sign painting and others
	D-4	Laboratories and studios	Clinical analysis laboratories without hospitalization, chemical, photographic and similar laboratories
Educational and physical culture	E-1	Schools in general	First, second- and third-degree schools, supplementary, pre-university and similar courses
	E-2	Special schools	Schools of arts and crafts, languages, general culture, foreign culture, religious schools and the similar
	E-3	Space for physical culture	Places for teaching and/or practicing martial arts, gymnastics (artistic, dance, bodybuilding and others), team sports (tennis, football and others that are not included in F-3), saunas, physiotherapy houses and similar
	E-4	Professional training center	Technical schools in general
	E-5	Pre-school	Daycare centers, nursery schools, early childhood education schools and similar
	E-6	Schools for people with disabilities	Schools for exceptional people, visually and hearing impaired and similar
Public meeting places	F-1	Museums and libraries	Museums, historical document centers, libraries and similar
	F-2	Religious temples	Churches, chapels, synagogues, mosques, temples, cemeteries, crematoriums, morgues, funeral rooms and similar
	F-3	Sports and exhibition centers	Stadiums, gymnasiums and swimming pools with stands, rodeos, racetracks, Sambadrome, arenas in general, skating rinks and similar
	F-4	Passenger terminals	Bus stations, subways, airports, helipads, transfer stations in general and similar
	F-5	Performing arts and auditoriums	Theaters in general, cinemas, operas, radio and television studio auditoriums, auditoriums in general and similar
	F-6	Social and entertainment clubs	Party rooms (buffet), clubs in general, bingo, billiards, target shooting, bowling and similar
	F-7	Temporary events	Temporary events with public concentration
	F-8	Place to eat (restaurants)	Restaurants, cafeterias, bars, cafes, canteens and similar
	F-9	Public recreation (zoo, parks)	Zoo, recreational parks and similar, installed in permanent buildings
	F-10	Permanent exhibition of animal objects	Halls and exhibition rooms for objects and animals, showrooms, art galleries, aquariums, planetariums and similar in permanent buildings
	F-11	Nightclubs	Nightclubs, dance clubs, dancing restaurants, pubs and similar

**Table 3** (continued)

Main Category	Code	Sub-category	Description and examples
Automotive Services	G-1	Garage WITHOUT public access and without supply	Automatic garages
	G-2	Garage WITH public access and without supply	Collective garages without automation, in general, without supply (except freight and collective vehicles)
	G-3	Location equipped with fuel supply	Fuel and service stations, garages (except freight and collective vehicles)
	G-4	Car shops	Vehicle repair shops, tire repair shops (without retreading); workshops and garages for freight and collective vehicles, agricultural and road machinery, engine grinding machines
	G-5	Hangars	Shelters for aircraft with or without fuel supply
	G-6	Marinas, ports, nautical garages	Management and auxiliary activities of water transport
Health and institutional service	H-1	Veterinary hospitals	Hospitals, clinics and veterinary offices and similar (accommodation with or without training is included)
	H-2	Places for people with physical or mental limitations	Nursing homes, orphanages, geriatric shelters, psychiatric hospitals, reformatories, treatment for drug and alcohol addicts and similar. All without cells
	H-3	Hospitals and similar	Hospitals, nursing homes, emergency rooms, inpatient clinics, outpatient clinics and emergency care centers, health and childcare centers and similar inpatient clinics
	H-4	Public offices, armed forces and police buildings	Barracks, police headquarters, police stations, fire departments and similar
	H-5	Places of restriction of freedom	Psychiatric hospitals, mental hospitals, reformatories, prisons in general (detention houses, penitentiaries, prisons) and similar institutions. All with cells
	H-6	Medical and dental clinics and offices	Medical clinics, general offices, hemodialysis units, outpatient clinics and similar. All without hospitalization
Industry	I-1	Industries where the fire load is equal to or less than 300 MJ/m <sup>2</sup>	Activities that handle materials with low risk of fire such as factories in general, where processes do not involve the intensive use of combustible materials (steel; radio and sound equipment; weapons; metal articles; plaster; stone sculptures; tools; photoengraving; jewelry; watches; soap; metalwork; fruit juice; crockery; metals; machines)
	I-2	Industries where 300 MJ/m <sup>2</sup> < fire load < 1200 MJ/m <sup>2</sup>	Activities that handle materials with medium fire risk such as: glassware; automobiles, distilled beverages; musical instruments; furniture; food carpentry shops, box factories and similar
	I-3	Industries where the fire load is equal to or greater than 1200 MJ/m <sup>2</sup>	Manufacture of explosives, industrial activities involving flammable liquids and gases, oxidizing materials, distilleries, refineries, waxes, synthetic foam, paints, rubber and similar
Warehouse	J-1	Deposits of non-combustible material	Buildings without an industrial process that store bricks, cement, metals and other non-combustible materials. All without packaging
	J-2	Deposits where the fire load is equal to or less than 300 MJ/m <sup>2</sup>	All types of deposits
	J-3	Deposits where 300 MJ/m <sup>2</sup> < fire load < 1200 MJ/m <sup>2</sup>	All types of deposits
	J-4	Deposits where the fire load is equal to or greater than 1200 MJ/m <sup>2</sup>	All types of deposits
Explosive	L-1	Trade	General trade in fireworks and similar
	L-2	Industry	Explosive material industry
	L-3	Deposit	Explosive material deposit
	L-4	Pyrotechnic show	Pyrotechnic show

**Table 3** (continued)

Main Category	Code	Sub-category	Description and examples
Special	M-1	Tunnels	Road-rail tunnel, intended for transporting passengers or various loads
	M-2	Flammable and combustible liquids or gases / Tanks or tank farms	Building intended for the production, handling, storage and distribution of combustible and flammable liquids or gases
	M-3	Communication center	Telephone exchanges, communication centers, energy transmission or distribution centers and similar
	M-4	Construction sites/Property under transformation	Sites under construction or demolition and similar
	M-5	Silos	Grain and similar warehouses
	M-6	Vegetation	Forest ecological reserve, forest park and similar
	M-7	Container Yard	Container storage in an open area
	M-8	Mobile phone towers	Metal tower with cabinets for telephone equipment
	M-9	Subdivision	Subdivision
	M-10	Transport and navigation	Passenger or merchandise transport activities, by rail, road, waterway and air. (no storage)
	M-11	Waste and garbage treatment	Waste collection, treatment and management, material recovery
	M-12	Power distribution center	Electrical substation
	M-13	Power Plants	Hydroelectric, thermoelectric, photovoltaic plant, wind plant
Primary sector	N-1	Botany	Cultivation of plants, fruits and similar
	N-2	Zootechnics	Animal husbandry inside buildings
	N-3	Mining	Extraction of ores and similar

to be standardized in the 27 Brazilian state legislations, configuring an initial movement to reorganize fire safety requirements in Brazil.

The other initial parameters require specific and more in-depth studies to analyze and discuss their efficiency and applicability, and only then decide on their standardization.

The classification by height presents divergences that can be eliminated but there needs to be a study on the limit ranges in which the requirements will be applied. This can be done by computer simulation of fire development and evacuation of people, so that theoretical data can be generated regarding the functionality of the limits to be established.

The classification by area, which is also divergent in legislation, can follow the same computer simulation procedure. Such a simulation can also include not only the area but also different architectural configurations (*layout*) to determine their influence on the development of the fire and its compartmentation.

The initial risk classification is the one that requires more studies with different approaches. The initial risk depends not only on the fire load but also on the ignition factors that may be present in the location; the state of maintenance of the equipment and electrical network; as well as the way in which materials are stored and distributed in the building.

Consensus on the requirements of FS systems and the parameters to be considered in this sizing can be reached on the initiative of the corporations themselves, without necessarily requiring a unified law. This understanding can make the standardization process faster and less bureaucratic. The objective of fire safety is to save lives and safeguard property. A joint effort is needed to facilitate access and application of FS standards by designers, inspectors and the community in general.

This study aims to continue a discussion that is already taking place about the need to standardize technical fire safety legislation. And, mainly, to propose a beginning of change that could positively impact the fire safety scenario in our country.

**Author contributions** M.B. wrote the main manuscript text. All authors reviewed the manuscript.

**Funding** Open access funding provided by FCTIFCCN (b-on). No funding was received for this study.

**Data availability** No datasets were generated or analysed during the current study.

## Declarations

**Conflict of interest** The authors declare no competing interests.

**Competing interests** The authors declare no competing interests.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

1. CBPMESP (2019) Instrução Técnica N° 03/2019. Terminologia de segurança contra incêndio. <https://cbaplang.corpodebombeiros.sp.gov.br/internetCB/#/LegislacaoConsulta>
2. Tavares RM (2009) An analysis of the fire safety codes in Brazil: Is the performance-based approach the best practice? *Fire Safety J* 44(5):749–755
3. Sun X, Cai N, Zhang W (2023) Discussing the development of domestic and foreign fire protection technical regulation and fire protection technical standard systems. *J Safe Sci Resilience*. ISSN 4(1):2666–4496. <https://doi.org/10.1016/j.jnlssr.2022.10.002>
4. Portugal (2008) Decreto Lei n.º 220/2008. Estabelece o regime jurídico da segurança contra incêndios em edifícios, abreviadamente designado por SCIE. Ministério da Administração Interna. <https://diariodarepublica.pt/dr/detalhe/decreto-lei/220-2008-439866>
5. Araújo MAS (2008) Papel do Corpo de Bombeiros na segurança contra incêndio. In: Seito, Alexandre Itiu et. al. (Coords). A segurança contra incêndio no Brasil. São Paulo: Projeto Editora, pp 297–310
6. Seito AI, Gill AA, Pannoni FD, Ono R, Silva SB, Carlo UD, Silva VP (2008) A segurança contra incêndio no Brasil. Projeto Editora, São Paulo
7. Hahnemann A, Corrêa C, Rabbani E (2017) Evaluación de seguridad contra incendio: método alternativo aplicado a edificaciones brasileña. *Revista Alconpat* 7(2):186–199. <https://doi.org/10.21041/ra.v7i1.178>
8. Brasil (1988) Constituição da República Federativa do Brasil de 1988. [https://www.planalto.gov.br/ccivil\\_03/constituicao/constituicaoconsolidado.htm](https://www.planalto.gov.br/ccivil_03/constituicao/constituicaoconsolidado.htm)
9. Rodrigues EE, Camargo (2016) Sistema de Gestão da Segurança contra Incêndio e Pânico nas Edificações: Fundamentação para uma Regulamentação Nacional. Tese de Doutorado, UFRGS
10. CBMAC (2022) Norma Técnica 01– Processos Administrativos. Anexo A. <https://cbmac.ac.gov.br/wp-content/uploads/2022/12/NT-01-Processos-administrativos.pdf>
11. CBMAL (2021) Instrução Técnica 01 – Processos Administrativos Parte 2. <https://saps.cbm.al.gov.br/portal/downloads>
12. CBMAP (2020) Norma Técnica 02 – Classificação das Edificações de Acordo com a Ocupação e Uso. <https://discip.cbm.ap.gov.br/nts>
13. Amazonas Governo do Estado (2004) Decreto n° 24054. Aprova o Regulamento do Sistema de Segurança contra Incêndio e Pânico em Edificações e Áreas de Risco. <https://sisgat.cbm.am.gov.br/portal/legislacoes?sort=numero&direction=desc>
14. Bahia Governo do Estado (2015) Decreto n° 16302. Regulamenta a Lei n° 12.929, de 27 de dezembro de 2013, que dispõe sobre a Segurança contra Incêndio e Pânico e dá outras providências. <https://www.legisweb.com.br/legislacao/?id=302697>
15. CBMCE (2008) Norma Técnica 01 – Procedimento Administrativo. <https://www.cepi.cb.ce.gov.br/download/normas-tecnicas-revogadas/>
16. CBMDF (2016) Norma Técnica 01 - Medidas de Segurança Contra Incêndio no Distrito Federal. <https://segurancacontraincendio.cbm.df.gov.br/wp-content/uploads/2021/11/NT-01-Medidas-de-Seguranca-Contra-Incendio-no-Distrito-Federal-1.pdf>
17. Espírito Santo Governo do Estado (2009) Decreto n° 2423-R. Regulamenta a Lei n° 9.269, de 21 de julho de 2009 e institui o Código de Segurança Contra Incêndio e Pânico (COSCIP) no âmbito do território do Estado e estabelece outras providências. <https://www.legisweb.com.br/legislacao/?id=126775>
18. CBMGO (2020) Norma Técnica 01 – Exigências de Medidas de Segurança Contra Incêndio e Pânico. <https://www.bombeiros.go.gov.br/sem-categoria/normas-tecnicas-do-cbmgo-2.html>
19. CBMMA (2021) Norma Técnica 01 – Procedimentos Administrativos. <https://cbm.ssp.ma.gov.br/cbmma/institucional/legislacao/>
20. CBMMT (2020) Norma Técnica 01 – Procedimentos Administrativos. Anexo A. <https://www.bombeiros.mt.gov.br/normas-tecnicas-revogadas>
21. Mato Grosso do Sul Governo do Estado (2013) Lei n° 4335. Institui o Código de Segurança contra Incêndio, Pânico e outros Riscos, no âmbito do Estado de Mato Grosso do Sul. <https://www.legisweb.com.br/legislacao/?id=253259>
22. Minas Gerais Governo do Estado (2020) Decreto n° 47998. Regulamenta a Lei n° 14.130, de 19 de dezembro de 2001, que dispõe sobre a prevenção contra incêndio e pânico no Estado, e estabelece regras para as atividades de fiscalização das medidas de prevenção e combate a incêndio e a desastres em estabelecimentos, edificações e áreas de reunião de público, nos termos dos arts. 3°, 4° e 5° da Lei Federal n° 13.425, de 30 de março de 2017, e dá outras providências. [https://www.bombeiros.mg.gov.br/storage/files/shares/decretos/Decreto\\_47.998\\_atualizado.pdf](https://www.bombeiros.mg.gov.br/storage/files/shares/decretos/Decreto_47.998_atualizado.pdf)
23. CBMPA (2019) Instrução Técnica 01 – Procedimentos Administrativos. Parte I – Exigências das Medidas de Segurança contra Incêndio e Emergências. <https://www.bombeiros.pa.gov.br/instrucoes-tecnicas/>
24. CBMPB (2023) Norma Técnica 04 - Classificação das Edificações e Áreas de Risco e Exigências das Medidas de Segurança contra Incêndio, Explosão e Controle de Pânico. <https://bravo.bombeiros.pb.gov.br/portal/wp-content/uploads/2023/07/NT-04-2023-CBMPB.pdf>
25. CBMPR (2018) Portaria n° 56/2018. Altera as normas de segurança contra incêndio do Corpo de Bombeiros da Polícia Militar do Paraná. [https://www.bombeiros.pr.gov.br/sites/bombeiros/arquivos\\_restritos/files/documento/2022-01/cscip\\_-\\_codigo\\_de\\_seguranca\\_contra\\_incendio\\_e\\_panico\\_-\\_10-01.pdf](https://www.bombeiros.pr.gov.br/sites/bombeiros/arquivos_restritos/files/documento/2022-01/cscip_-_codigo_de_seguranca_contra_incendio_e_panico_-_10-01.pdf)
26. Pernambuco Governo do Estado (2022) Decreto n° 53308. Aprova o Código de Segurança Contra Incêndio e Pânico para o Estado de Pernambuco – COSCIP. <https://www.legisweb.com.br/legislacao/?id=434801>
27. Piauí Governo do Estado (2018) Decreto n° 17688. Institui o Regulamento de Segurança Contra Incêndio das Edificações e Áreas de Risco do Estado do Piauí e estabelece outras providências. <https://www.legisweb.com.br/legislacao/?id=358171>
28. Rio de Janeiro Governo do Estado (2018) Decreto n° 42. Dispõe sobre o Código de Segurança Contra Incêndio e Pânico COSCIP, no âmbito do Estado do Rio de Janeiro. <https://www.legisweb.com.br/legislacao/?id=372879>

29. CBMRN (2022) Instrução Técnica 01 – Procedimentos Administrativos. Parte 1 – Procedimentos Gerais e Classificação das Edificações. [https://sistemascbm.rn.gov.br/sernten/portal/its\\_2022/](https://sistemascbm.rn.gov.br/sernten/portal/its_2022/)
30. Rio Grande do Sul Governo do Estado (2014) Decreto no 51803. Estabelece normas sobre segurança, prevenção e proteção contra incêndio nas edificações e áreas de risco de incêndio no Estado do Rio Grande do Sul. <https://www.legisweb.com.br/legislacao/?id=274625>
31. CBMRO (2022) Instrução Técnica 01 – Procedimentos administrativos. Anexo A. <https://www.cbm.ro.gov.br/>
32. Roraima Governo do Estado (2004) Lei Complementar nº 82. Aprova o Código Estadual de Proteção Contra Incêndio e Emergência de Roraima e dá outras providências. <https://sapl.al.rr.leg.br/ta/2214/text?>
33. CBMSC (2022) Instrução Normativa 1 – Procedimentos administrativos. Parte 2 – Sistemas e Medidas de Segurança Contra Incêndio e Pânico. [efaidnbmnnnibpcjpcglclefindmkaj](https://www.al.sp.gov.br/repositorio/legislacao/decreto/2018/decreto-63911-10.12.2018.html)
34. São Paulo Governo do Estado (2018) Decreto nº 63911. Institui o Regulamento de Segurança Contra Incêndios das edificações e áreas de risco no Estado de São Paulo e dá providências. <https://www.al.sp.gov.br/repositorio/legislacao/decreto/2018/decreto-63911-10.12.2018.html>
35. CBMSE (2021) Instrução Técnica 01 – Procedimentos Administrativos. Anexo U – Classificação das edificações e tabelas de risco quanto à ocupação. <https://dat.cbm.se.gov.br/portal/downloads#op2>
36. CBMTO (2022) Norma Técnica 01 – Procedimentos Administrativos. Anexo A. <https://prevenir.bombeiros.to.gov.br/pags/menu/legi/>
37. Dal Ponte ST, Dornelles CFD, Arquilla B, Bloem C (2015) Roblin P (2015) Mass-casualty Response to the Kiss Nightclub in Santa Maria. *Brazil Prehosp Disaster Med* 30(1):93–96. <https://doi.org/10.1017/S1049023X14001368>
38. Brasil (2017) Lei 13.425/2017. Estabelece diretrizes gerais sobre medidas de prevenção e combate a incêndio e a desastres em estabelecimentos, edificações e áreas de reunião de público e dá outras providências. [https://www.planalto.gov.br/ccivil\\_03/\\_ato2015-2018/2017/lei/L13425.htm](https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/lei/L13425.htm)
39. IBGE (2024) Tabelas de Códigos e Denominações (Cnae Completa). Disponível em: <https://cnae.ibge.gov.br/>

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.