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INTERNATIONAL ASSOCIATION OF FIRE AND RESCUE SERVICES

Center of Fire Statistics

World Fire Statistics

INTERNATIONALE VEREINIGUNG DES FEUERWEHR- UND RETTUNGSWESEN
L'ASSOCIATION INTERNATIONALE DES SERVICES D'INCENDIE ET DE SECOURS

International Association of Fire and Rescue Services
Asociación Internacional de Servicios de Fuego y Rescate
Internationale Vereinigung des Feuerwehr- und Rettungswesens

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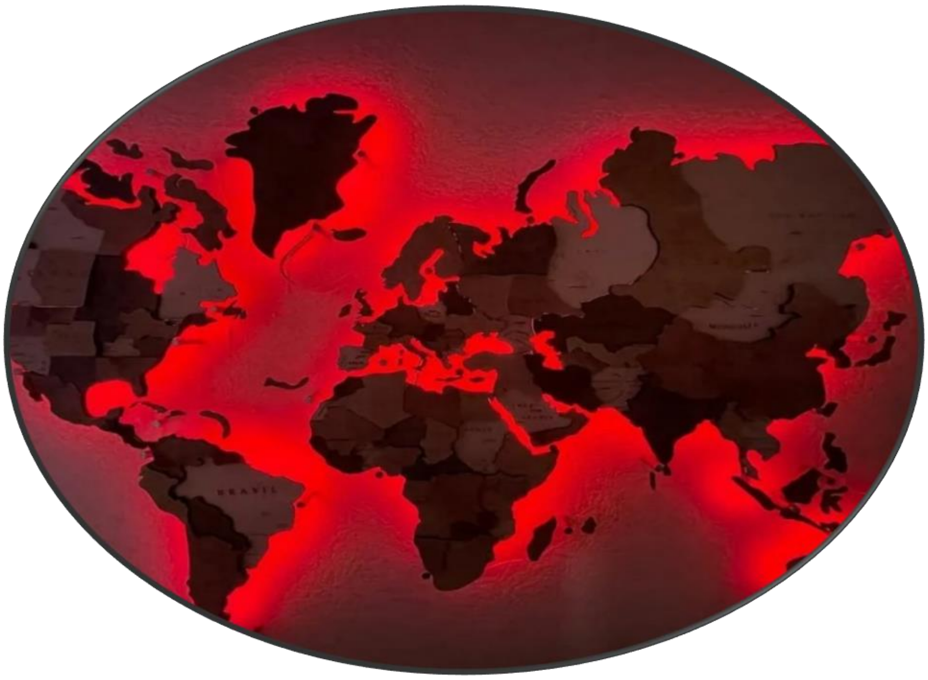
Center for Fire Statistics

World Fire Statistics
Estadísticas Mundiales de Bomberos
Die Feuerwehrstatistik der Welt

Report / Informe / Bericht № 30



All statistical data presented in this report were obtained from responses to the requests of the Fire Statistics Center of CTIF (CFS CTIF) and published previously in official statistical information of various countries.
The data of past years has, in some cases, been updated with revised information.
When comparing statistics of countries and cities, it is necessary to keep in mind that every country has its own rules for reporting fires, fire deaths, and fire injuries. These rules change from time to time.
The authors are always grateful for suggestions to improve the Center for Fire Statistics' work.

Todos los datos estadísticos presentados en el informe se han obtenido a partir de las respuestas a las solicitudes del Centro de Estadísticas de Incendios del CTIF (CFS CTIF) y se han publicado anteriormente en la información estadística oficial de varios países.
Los datos de años anteriores se han actualizado, en algunos casos, con información revisada.
Al comparar las estadísticas de países y ciudades, es necesario tener en cuenta que cada país tiene sus propias normas para informar sobre los incendios, las muertes por incendio y los heridos por incendio. Estas normas cambian de vez en cuando.
Los autores siempre agradecen las sugerencias para mejorar el trabajo del Centro de Estadísticas de Incendios.

Alle im Bericht vorgestellten statistischen Daten wurden den Fragebögen des Center for Fire Statistics des CTIF (CFS CTIF) sowie den offiziell veröffentlichten statistischen Berichten verschiedener Staaten entnommen. Die Daten vergangener Jahre wurden im Zuge neuerer Informationen aktualisiert.
Beim Vergleich der statistischen Daten einzelner Staaten und verschiedener Jahre muss beachtet werden, dass in einzelnen Ländern spezifische Regeln für die Erfassung von Bränden, der Brandtoten- und Verletztenzahlen gelten, die sich ggf. auch über die Jahre hinweg verändert haben.
Die Autoren sind wie immer für Hinweise, Kritiken und Vorschläge zur Verbesserung der internationalen Feuerwehrstatistik dankbar.

We would like to express our special thanks to Organización de Bomberos Americanos (OBA) for friendly support in the preparation of Report No. 30.

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Introduction

The CFS CTIF hereby publishes Report № 30 containing information from countries and cities around the world on fire statistics for 2023 as well as type of fire service calls, number of fires, fire victims and firefighter fatalities for 2019 – 2023.

Statistics for 2023 contain data from 46 countries, representing 1.5 bln. inhabitants, and 25 cities. The study includes the type of fire service calls, the number of fires, fire victims, and firefighters' fatalities for 2019-2023, respectively, in 55, 76, 71, and 29 countries. The type of fire injuries for 2019-2023 were researched in 54 countries of the World. In addition, data was collected on fire services in 66 countries around the World. That is how the formation of world fire statistics continues.

In this report, **Table 1.1** contains generalized data on the situation with fires in the World from 1993 to 2023. The data for all years are constantly updated and supplemented as new sources of information become available. This indicates that more and more countries of the World are involved in the regular analysis of national fire statistics and their publication. It is therefore expected that the data for 2023 will also be replenished in the future.

Tables 1.2-1.6 show fire statistics for the year 2023.

Tables 1.7-1.12 show the type of fire service calls, the number of fires, fire victims, and firefighters' deaths for 2019-2023.

Table 1.13 contains information on fire services in 65 countries from 2010 to 2023.

Table 1.14 presents the ratio of women to men in the fire service. **Table 1.15** provides information on the number of junior firefighters.

Table 1.16 presents the distribution of fires by fire causes.

Tables 2.1-2.5 present fire statistics in 25 cities around the World for the year 2023.

Tables 2.6-2.8 show the calls, fires and fire victims in 56 cities of the World from 2019 to 2023. Finally, **Table 2.9** contains information on fire services in 77 cities around the World.

Introducción

El Centro de Estadísticas de Incendios de la Asociación Internacional de Servicios de Fuego y Rescate (CFS CTIF) pone a disposición de los especialistas el siguiente informe, el №30, que contiene las estadísticas de incendios de algunos países y ciudades del mundo durante el año 2023, así como el tipo de llamadas al servicio de bomberos, el número de incendios, sus víctimas y los fallecimientos de bomberos en estos países y ciudades del mundo para 2019-2023.

Las estadísticas del 2023 contienen datos sobre 40 países, representando 1.5 mil millones. habitantes, y 25 ciudades. El tipo de llamadas, los incendios, sus víctimas y de los fallecimientos de los bomberos para 2019-2023 se han estudiado respectivamente en 55, 76, 65 y 29 países. El tipo de lesiones por incendio para 2019-2023, por su parte, fue investigada en 54 países del mundo. Además, se recogieron datos sobre los servicios de bomberos en 66 países. De este modo, continúa la formación de las estadísticas mundiales sobre incendios.

En este informe, el **Cuadro 1.1** contiene datos generales sobre la situación de los incendios en el mundo para el periodo 1993-2023, y los datos de todos los años se actualizan y complementan constantemente (a medida que se dispone de nuevas fuentes de información). Esto significa que cada vez más países del mundo participan en el análisis regular de las estadísticas nacionales sobre incendios y su publicación en los medios de comunicación. Confiamos en que los datos correspondientes a 2023 se repongan en el futuro.

Los **Cuadros 1.2-1.6** muestran las estadísticas de incendios para 2023 en varios países del mundo. Los **Cuadros 1.7-1.12** muestran el tipo de llamadas al servicio de bomberos, el número de incendios, sus víctimas y el fallecimiento de bomberos en los países del mundo para 2019-2023. El **Cuadro 1.13** contiene información sobre los servicios de bomberos en 65 países en 2010-2023. El **Cuadro 1.14** presenta la proporción de mujeres y hombres en el servicio de bomberos en algunos países del Mundo. El **Cuadro 1.15** ofrece información sobre el número de bomberos jóvenes en algunos países.

Los **Cuadros 2.1-2.5** muestran las estadísticas de incendios para el año 2021 en 25 ciudades de todo el mundo. Los **Cuadros 2.6-2.8** muestran el tipo de incendios y sus víctimas en las ciudades del mundo para 2019-2023. El **Cuadro 2.9** contiene información sobre los servicios de bomberos en 77 ciudades del mundo.

Einführung

Das CFS CTIF stellt der Fachwelt den aktuellen Bericht № 30 vor, der die Feuerwehrstatistik vieler Staaten und Städte für das Jahr 2023 enthält. Weiter werden Informationen über die Entwicklung der Einsätze, der Brandzahlen und der Brandopferzahlen in der Welt für 2019-2023 vorgestellt.

Die Statistik für das Jahr 2023 enthält Daten aus 46 Staaten, und repräsentiert 1,5 Mrd. Einwohner sowie 25 Städte der Erde. Die Zahlen zur Entwicklung der Feuerwehreinsätze, der Brände, deren Opfer und die Anzahl verunglückter Feuerwehrleute für den Zeitraum 2019-2023 liegen entsprechend aus 55, 76, 71 bzw. 29 Staaten vor. Informationen zu Verletzten bei Bränden (2019-2023) stehen aus 54 Staaten zur Verfügung. Weiter wurden die statistischen Angaben zu den Feuerwehren aus 66 Staaten in die Statistik aufgenommen. So setzt sich der Prozess der Formierung der Weltfeuerwehrstatistik fort.

Im vorliegenden Bericht stellt die **Tabelle 1.1** die zusammengefassten Daten zur Brandsituation in der Welt für den Zeitraum 1993-2023 vor. Die Daten wurden, je nach Vorliegen neuer Statistiken, ständig ergänzt und aktualisiert. Das bedeutet, dass sich immer mehr Staaten mit der regulären nationalen Brandstatistik und ihrer Veröffentlichung in den Medien beschäftigen. Wir sind sicher, die Daten des Jahres 2023 zukünftig weiter vervollständigen zu können.

In den **Tabellen 1.2** bis **1.6** wird die Brandstatistik einiger Staaten für 2023 analysiert.

In den **Tabellen 1.7** bis **1.12** wird die Dynamik der Feuerwehreinsätze, der Brandzahlen und der Opferzahlen in den Staaten für den Zeitraum 2019-2023 vorgestellt.

Tabelle 1.13 illustriert die Situation der Feuerwehren in 65 Staaten der Erde im Zeitraum 2010-2023. **Tabelle 1.14** zeigt eine Übersicht zum Mengenverhältnis zwischen weiblichen und männlichen Feuerwehrangehörigen in ausgewählten Staaten. **Tabelle 1.15** zeigt eine Übersicht zur Anzahl der Jugendfeuerwehren in ausgewählten Staaten.

In den **Tabellen 2.1** bis **2.5** wird die Feuerwehrstatistik für 2023 aus 25 Großstädten vorgestellt. Die Tabellen **2.6-2.8** beinhalten die Entwicklung der Brandzahlen und deren Opfer in Großstädten für 2019-2023. Die **Tabelle 2.9** zeigt Informationen über die Feuerwehren in 77 Großstädten der Welt.

Brief comments

1. Countries of the World

Table 1.1 shows that the CFS CTIF, established in 1995, annually summarized statistical data from 27-57 countries of the World, in which 0.9-3.8 billion people lived. In 1993, 40% of the World's population lived in the 39 countries surveyed. In 2008, more than 50% of the World's population lived in the 31 countries surveyed.

In the surveyed countries, 2.5-4.5 million fires were recorded annually, in which 17-62 thousand people died. In just 30 years, more than 1.1 million people have become victims of 114 million fires in these countries.

Figure 1.1 shows trends in: a) number of fires per 1000 inh.; b) number of fire deaths per 100 thous. inh.; c) number of fire deaths per 100 fires. Red color shows Min and Max values for separate countries in every year.

Table 1.2 summarizes the volume of work and fire situation in 46 countries in 2023.

Table 1.2 shows that in 2023, in 46 countries surveyed, in which 1.5 billion people lived (1/5 of the World's population), 55 million calls of fire and rescue services were registered, of which 3.1 million (5.6% of all calls) were related to fires. 17.4 thousand people died during these fires, and 45 thousand people were injured. That means that for every 1,000 people in these countries, there was an average of 36 calls per year, of which 2.0 were fires. At the same time, for every 100 thousand people, on average, 1.1 people died, and 3.0 people were injured in fires during the year, and for every 100 fires, an average of 0.5 people died, and 1.5 people were injured.

Table 1.3 and **Figure 1.2** show the nature of operational work of fire services in 20 countries. More than 55 million fire service calls were analyzed in 2023.

The share of fires in the total number of fire service calls is 4.5%, calls to accidents (for technical assistance and rescue) 2.6, and calls for medical aid are 60.8% (mainly in France, Ecuador, Singapore, Ireland, and the USA), false alarms account for 10.7% and others 21.4%.

Table 1.4 and **Figure 1.3** show the distribution of fires by place of origin in 20 countries. Approximately 33.6% of all fires occur in buildings (25.5% in residential buildings and 8.1% in all other facilities), about 11.5% in transport means, 1.1% in forests, 17.6% fires of grass and bushes, 13.9% in trash and landfills and 22.2% other fires. When analyzing the data in this table, it should be borne in mind that different countries have their own rules for recording fires for the categories presented.

From the final line of **Table 1.4,** it follows that 45.1% of all reported fires occurred in buildings (including chimney fires) and transport.

In **Tables 1.5-1.6** and **Figures 1.4-1.5**, the distributions of those killed and injured in fires by place of origin are presented. These data show that 85.8% of all deaths (from 0% in Croatia to 98% in Denmark) and 73.6% of all injuries (from 1.8% in Croatia to 89.4% in Kazakhstan) occur in residential buildings.

Tables 1.7-1.10 contain information on the type and number of fire service calls, fires, and fire victims for 2019-2023 in 55-76 countries. In these countries, there are an average of 64 million fire service calls and 3.8 million fires per year, in which about 26 thousand people die and approximately 56 thousand people are injured.

Figure 1.6 shows that the largest number of calls per 1,000 people (average figures for the period 2019-2023 (**Table 1.7**) occur in the Finland, Luxemburg, Czech Republic. Conversely, most fires per 1,000 people (averages for the period 2019-2023, **Table 1.8**) - are in Cyprus, Austria and Uruguay (**Figure 1.7**).

Figure 1.8 shows that most fire deaths per 100 thousand people (average values for 2019-2023, **Table 1.9**) occur in Belarus, Russia and Ukraine. **Figure 1.9** shows the distribution of fire deaths per 100 fires (average values for 2019-2023, **Table 1.9**).

Figure 1.10 shows that most fire injuries per 100 thousand people (average values for 2019-2023, **Table 1.10**) occur in France, Latvia and Portugal. **Figure 1.11** shows the distribution of fire injuries per 100 fires (average values for 2019-2023, **Table 1.10**).

Tables 1.11-1.12 present data on the deaths and injuries of firefighters in 26 countries. In 2023, 92 firefighters died, and 64 thous. were injured in these countries.

Table 1.13 and **Figures 1.12-1.14** show the staff numbers of fire services in 65 countries at the beginning of the 21st century. From **Table 1.13,** it follows that 3.2 billion inhabitants of these countries are protected from fires by 15.4 million firefighters, of which 13.8 million are volunteers.

Table 1.14 and **Figures 1.15** presents data on the distribution of firefighters by gender in 45 countries.

Table 1.15 presents data on the number of young firefighters in 20 countries.

Table 1.16 and **Figure 1.16** presents the distribution of fires by fire causes. Main causes are carelessness – 27%, fireplace, strove – 11% and electricity equipment failure – 16%.

Figures 1.17-1.18 show the distribution of people who died from “fire, heat and hot substances” in 2019, according to the World Health Organization (WHO).

2. Cities of the World

It follows from **Table 2.1** that, in the 25 cities surveyed, for every 1,000 people in 2023, there were 27.9 fire service calls, of which 2.2 were fires. It also shows that, an average of 0.6 people died, and 2.4 people were injured for every 100 thousand people in fires in all the cities listed in the table in 2023.

Figures 2.1-2.4 show the distribution of cities by the number of fire service calls and fires per 1,000 people per year (average figures for the period 2019-2023, **Tables 2.6-2.7**) and the number of deaths in fires per 100 thousand people, and per 100 fires per year (average figures for the period 2019-2023, **Table 2.8**).

Table 2.2 and **Figure 2.5** provide data on the nature of fire services work in 19 cities of the World.

The share of fires of the total number of fire service calls for 19 cities averaged 8.6%. Accident visits and technical assistance accounted for 8.1% of all calls; trips to provide medical care accounted for 54.2% of all fire service calls. False exits account for 24.1% of all calls and 5.0% for other exits.

In **Table 2.3** and **Figure 2.6,** objects and places of occurrence of fires in 18 cities of the World are considered. Summarizing these data, shows that 34.9% of all fires occurred in buildings (including chimneys) (20.9% in residential buildings and 14.0% in all other buildings), 8.0% in transport (i.e. e. more than 43% of all fires originated either in buildings or in vehicles); forest fires, garbage, landfills, grass, and bushes accounted for 27.2% of all fires.

Tables 2.4 and **2.5** and **Figures 2.7** and **2.8** show the distribution of people killed and injured in fires by occupancy in 13 cities around the World.

They show that 76.43% of the fatalities and 70.5% of the injuries occurred in residential buildings. 91,7% of the dead and 95.3% of the injuries happened in all buildings.

Table 2.6 shows the type of calls for 2019-2023 in 49 cities around the World. These cities have 210 million inhabitants and annually register an average of 4.7 million fire service calls per year (i.e., 22.4 calls per 1,000 people).

Table 2.7 shows the number of fires for 2019-2023 in 56 cities around the World. They have 305 million inhabitants, and an average of 295 thousand fires per year are recorded annually (i.e., 1.0 fires per 1,000 people).

Table 2.8 shows the number of fire fatalities from 2019 to 2023 in 51 cities around the World. Two hundred seventy-nine million people inhabit them, and annually an average of 1,434 people die in fires, i.e., for every 100 thousand people, on average, there were 0.5 fire fatalities.

Table 2.9 and **Figures 2.9-2.12** present data on the number of firefighters and their technical equipment at the beginning of the 21st century for 77 cities. There are more than 330 million people in these cities. They were served by approximately 246 thous. firefighters, with an average of 1 professional firefighter per 1,647 people (**Figure 2.9**) and 17 sq. km per fire station (**Figure 2.12**). These data should be of some interest to specialists.

Breves comentarios

1. Países del mundo

El **Cuadro 1.1** muestra que el CFS CTIF, creado en 1995, resume anualmente los datos estadísticos de entre 27 y 57 países, en los que viven entre 900 y 3800 millones de personas. En 1993, el 40% de la población mundial vivía en los 39 países estudiados. En 2008, más del 50% de la población mundial vivía en 31 países.

En los países encuestados se registran anualmente entre 2,5 y 4,5 millones de incendios, en los que fallecen entre 17 y 62 mil personas. En sólo 30 años, más de 1,1 millones de personas han sido víctimas de 114 millones de incendios en estos países.

La Figura 1.1 muestra las tendencias en: a) número de incendios por cada 1000 inh.; b) Número de muertes por incendio por cada 100 mil. Inh.; c) Número de muertes por incendio por cada 100 incendios. El color rojo muestra los valores mínimo y máximo de cada año.

El **Cuadro 1.2** resume el volumen de trabajo y la situación de los incendios en 46 países en 2023.

El **Cuadro 1.2** muestra que, en 2023, en los 46 países estudiados, en los que viven 1.500 millones de personas (1/5 de la población mundial), se registraron 55 millones de salidas de los servicios de bomberos y salvamento, de las cuales 3,1 millones (el 5,6% de todas las llamadas) estaban relacionadas con incendios. En estos incendios fallecieron 17,4 mil personas y 45 mil resultaron heridas. Esto significa que, por cada 1.000 personas en estos países, hubo un promedio de 36 salidas de unidades al año, de las cuales 2,0 fueron incendios. Al mismo tiempo, por cada 100 mil personas, fallecieron en promedio 1,1 personas y 3,0 resultaron heridas en incendios durante el año, y por cada 100 incendios, fallecieron en promedio 0,5 personas y 1,5 resultaron heridas.

La Tabla 1.3 y la **Figura 1.2** muestran la naturaleza del trabajo operativo de los servicios de bomberos en 20 países. En 2023 se analizaron más de 55 millones de llamadas a los bomberos.

La proporción de incendios en el número total de llamadas a los servicios de bomberos es del 4,5%, las llamadas a accidentes (para asistencia técnica y rescate) del 2,6% y las llamadas de ayuda médica son del 60,8% (principalmente en Francia, Ecuador, Singapur, Irlanda y Estados Unidos), las falsas alarmas representan el 10,7% y otras el 21,4%.

La Tabla 1.4 y la **Figura 1.3** muestran la distribución de los incendios por lugar de origen en 20 países. Aproximadamente el 33,6% de todos los incendios ocurren en edificios (25,5% en edificios residenciales y 8,1% en todas las demás instalaciones), alrededor del 11,5% en medios de transporte, el 1,1% en bosques, el 17,6% en incendios de hierba y arbustos, el 13,9% en basura y vertederos y el 22,2% otros incendios. Al analizar los datos de esta tabla, se debe tener en cuenta que los diferentes países tienen sus propias reglas para registrar incendios para las categorías presentadas.

De la línea final de la **Tabla 1.4,** se deduce que el 45,1% de todos los incendios reportados ocurrieron en edificios (incluidos incendios de chimeneas) y transporte.

En **los cuadros 1.5-1.6** y **1.4-1.5** se presenta la distribución de los muertos y heridos en incendios por lugar de origen. Estos datos muestran que el 85,8% de todas las muertes (del 0% en Croacia al 98% en Dinamarca) y el 73,6% de todas las lesiones (del 1,8% en Croacia al 89,4% en Kazajistán) se producen en edificios residenciales.

Los cuadros 1.7 a 1.10 contienen información sobre el tipo y el número de llamadas a los servicios de bomberos, incendios y víctimas de incendios para 2019-2023 en 55-76 países. En estos países, hay un promedio de 64 millones de llamadas a los servicios de bomberos y 3,8 millones de incendios por año, en los que mueren alrededor de 26 mil personas y aproximadamente 56 mil personas resultan heridas.

La figura 1.6 muestra que el mayor número de llamadas por cada 1.000 personas (cifras medias para el período 2019-2023 (**tabla 1.7**)) se producen en Finlandia, Luxemburgo y República Checa. Por el contrario, la mayoría de los incendios por cada 1.000 personas (promedios para el período 2019-2023, **Tabla 1.8**) se encuentran en Chipre, Austria y Uruguay (**Figura 1.7**).

La figura 1.8 muestra que la mayoría de las muertes por incendios por cada 100 mil personas (valores promedio para 2019-2023, **tabla 1.9**) ocurren en Bielorrusia, Rusia y Ucrania. **La Figura 1.9** muestra la distribución de muertes por incendio por cada 100 incendios (valores promedio para 2019-2023, **Tabla 1.9**).

La Figura 1.10 muestra que la mayoría de las lesiones por incendio por cada 100 mil personas (valores promedio para 2019-2023, **Tabla 1.10**) ocurren en Francia, Letonia y Portugal. **La Figura 1.11** muestra la distribución de lesiones por incendio por cada 100 incendios (valores promedio para 2019-2023, **Tabla 1.10**).

En los cuadros 1.11 y 1.12 se presentan datos sobre las muertes y lesiones de bomberos en 26 países. En 2023 murieron 92 bomberos y 64 mil. fueron heridos en estos países.

La Tabla 1.13 y las **Figuras 1.12 a 1.14** muestran el número de personal de los servicios de bomberos en 65 países a principios del siglo XXI. De **la Tabla 1.13 se** deduce que 3.200 millones de habitantes de estos países están protegidos contra los incendios por 15,4 millones de bomberos, de los cuales 13,8 millones son voluntarios.

En el cuadro 1.14 y en el **gráfico 1.15** se presentan datos sobre la distribución de los bomberos por género en 45 países.

En el cuadro 1.15 se presentan datos sobre el número de jóvenes bomberos en 20 países.

La Tabla 1.16 y la **Figura 1.16** presentan la distribución de los incendios por causas de incendio. Las principales causas son el descuido (27%), la chimenea (11%) y la falla de los equipos eléctricos (16%).

Las figuras 1.17-1.18 muestran la distribución de las personas que murieron por "fuego, calor y sustancias calientes" en 2019, según la Organización Mundial de la Salud (OMS).

2. Ciudades del mundo

Del **Cuadro 2.1** se desprende que, en primer lugar, en las 25 ciudades encuestadas, en promedio, por cada 1.000 personas en 2023, se produjeron 27,9 llamadas al servicio de bomberos, de las cuales 2,2 fueron incendios; en segundo lugar, por cada 100 mil personas afectadas por incendios en 2020, en todas las ciudades enumeradas en la tabla, un promedio de 0,6 personas falleció y 2,4 personas resultaron heridas.

Los **Gráficos 2.1-2.4** muestran la distribución de las ciudades según el número de llamadas al servicio de bomberos y de incendios por cada 1.000 personas al año (cifras promedio para el periodo 2019-2023, tablas 2.6-2.7) y el número de fallecidos en incendios por cada 100 mil personas, y por cada 100 incendios al año (cifras promedio para el periodo 2019-2023, tabla 2.8).

El **Cuadro 2.2** y el **Gráfico 2.5** proporcionan datos sobre la naturaleza del trabajo de los servicios de bomberos en 19 ciudades del mundo.

La proporción de los incendios en el volumen total de llamados para 19 ciudades es, en promedio, del 8,6%; los servicios por accidentes y asistencia técnica en total representan el 8,1%; los servicios de asistencia médica representan el 54,2%; las falsas llamadas representan el 24,1% de todas las llamadas y el 5,0% son otros servicios.

En el **Cuadro 2.3** y en el **Gráfico 2.6** se consideran los objetos y lugares de ocurrencia de los incendios en 18 ciudades del mundo. Resumiendo estos datos, podemos decir que el 34,9% de todos los incendios se produjeron en edificios (incluyendo chimeneas) (el 20,9% en edificios residenciales y el 14,0% en todos los demás edificios), en el transporte - el 8,0% (es decir, más del 43% de todos los incendios se originaron en edificios o en vehículos); los incendios forestales, la basura, los vertederos, la hierba, los arbustos representaron el 27,2% de todos los incendios.

Los **Cuadros 2.4 y 2.5** y los **Gráficos 2.7 y 2.8** muestran la distribución de personas fallecidas y heridas en incendios de diversas estructuras en 13 ciudades del mundo.

De esta tabla se desprende que el 76,4% de los fallecidos y el 70,5% de los heridos se produjeron en zonas residenciales. En total, el 91,7% de los fallecidos y el 95,3% de los heridos se produjeron en todos los tipos de edificios.

El **Cuadro 2.6** muestra el tipo de llamadas para 2019-2023 en 49 ciudades de todo el mundo. Estas ciudades tienen 210 millones de habitantes y registran anualmente un promedio de 4,7 millones de llamadas al servicio de bomberos (es decir, 22,4 llamadas por cada 1.000 personas).

El **Cuadro 2.7** muestra el tipo de incendios para 2019-2023 en 56 ciudades de todo el mundo. En total, tienen 305 millones de habitantes y se registra un promedio de 295 mil incendios al año (es decir, 1,0 incendios por cada 1.000 personas).

El **Cuadro 2.8** muestra la cantidad de víctimas por incendios para 2019-2023 en 51 ciudades de todo el mundo. En ellas habitan 279 millones de personas y anualmente fallece un promedio de 1.434 personas en incendios, es decir, por cada 100 mil personas, en promedio, hubo 0,5 víctimas de incendios.

El **Cuadro 2.9** y los **Gráficos 2.9-2.12** presentan datos sobre el número de efectivos de los servicios de extinción de incendios (y su equipamiento técnico) a principios del siglo XXI en 77 ciudades del mundo. En estas ciudades viven más de 330 millones de personas. Están atendidas por unos 246.000 bomberos, con un promedio de 1 bombero profesional por cada 1.647 personas (**Gráfico 2.9**), y un promedio de 17 km^2 por estación de bomberos (**Gráfico 2.12**). Estos datos deberían ser de cierto interés para los especialistas.

Kurze Kommentare

1. Länder der Welt

Aus **Tabelle 1.1** folgt, dass das CFS CTIF (es wurde im Jahr 1995 gegründet) jährlich die statistischen Daten aus 27-57 Staaten verarbeitet, in denen 0,9-3,8 Mrd. Menschen lebten. Im Jahr 1993 lebten in den 39 untersuchten Staaten 40 % der Weltbevölkerung. Im Jahr 2008 lebten in 31 Staaten mehr als 50 % der Weltbevölkerung.

In den untersuchten Staaten wurden jährlich 2,5-4,5 Mio. Brände registriert. Dabei kamen 17.000 - 62.000 Menschen ums Leben. Innerhalb von 30 Jahren verloren in den untersuchten Staaten bei 114 Mio. Bränden ca. 1,1 Mio. Menschen ihr Leben.

Bild 1.1 zeigt die Trends: a) Anzahl der Brände per 1.000 Einwohner; b) Anzahl der Toten bei Bränden per 100.000 Einwohner; c) Anzahl der Brandtoten je 100 Brände. Die roten Linien illustrieren das Min. bzw. Max. für die einzelnen Staaten in jedem Jahr.

In **Tabelle 1.2** werden für das Jahr 2023 die verdichteten Kennzahlen zum Arbeitsumfang der Feuerwehren sowie zur Brandsituation in 46 Staaten vorgestellt.

Aus **Tabelle 1.2** folgt, dass im Jahr 2023 in den 46 untersuchten Staaten mit einer Bevölkerung von über 1,5 Mrd. Menschen (1/5 der Gesamtbevölkerung des Planeten) mehr als 55 Millionen Feuerwehreinsätze registriert wurden. Davon waren 3,1 Mio. (5,6 %) Einsätze mit Bränden verbunden. Bei diesen Bränden verloren rund 17.400 Menschen ihr Leben. Weitere 45.000 Menschen wurden bei Bränden verletzt. Das bedeutet, dass auf je 1.000 Einwohner dieser Staaten jährlich im Mittel 36 Feuerwehreinsätze entfallen, davon sind 2,0 Brandeinsätze. Dabei kommen je 100.000 Einwohner im Mittel 1,1 Menschen bei Bränden ums Leben. Weitere 3,0 Menschen je 100.000 der Bevölkerung wurden verletzt. Auf je 100 Brände entfallen somit im Mittel 0,5 Tote und 1,5 Verletzte.

Tabelle 1.3 und **Abbildung 1.2** zeigen die Art der Einsatzarbeit der Feuerwehren in 20 Ländern. Im Jahr 2023 wurden mehr als 55 Millionen Feuerwehreinsätze analysiert.

Der Anteil der Brände an der Gesamtzahl der Feuerwehreinsätze beträgt 4,5 %, der Anteil der Unfälle (für technische Hilfe und Rettung) 2,6 % und der Anteil der medizinischen Hilfe 60,8 % (vor allem in Frankreich, Ecuador, Singapur, Irland und den USA); der Anteil von Fehlalarmen beträgt 10,7 % und die sonstigen Einsätze 21,4 %.

Tabelle 1.4 und **Abbildung 1.3** zeigen die Verteilung der Brände nach den Orten der Brandentstehung in 20 Ländern. Etwa 33,6 % aller Brände ereignen sich in Gebäuden (25,5 % in Wohngebäuden und 8,1 % in allen anderen Einrichtungen), etwa 11,5 % in Verkehrsmitteln, 1,1 % in Wäldern, 17,6 % Brände waren Gras- und Buschbrände, 13,9 % in Müllplätzen und deren Deponien und 22,2 % waren sonstige Brände. Bei der Analyse der Daten in dieser Tabelle ist zu berücksichtigen, dass die verschiedenen Länder ihre eigenen Regeln für die Erfassung von Bränden für die dargestellten Kategorien haben.

Aus der letzten Zeile von **Tabelle 1.4** ergibt sich, dass 45,1 % aller gemeldeten Brände in Gebäuden (einschließlich Schornsteinbrände) und im Verkehrssektor auftraten.

In den **Tabellen 1.5-1.6** und **1.4-1.5** sind die Verteilungen der bei Bränden Getöteten und Verletzten nach Herkunftsorten dargestellt. Diese Daten zeigen, dass 85,8 % aller Todesfälle (von 0 % in Kroatien bis 98 % in Dänemark) und 73,6 % aller Verletzungen (von 1,8 % in Kroatien bis 89,4 % in Kasachstan) in Wohngebäuden auftreten.

Die Tabellen 1.7-1.10 enthalten Informationen über die Art und Anzahl der Feuerwehreinsätze, Brände und Brandopfer für den Zeitraum 2019-2023 in 55-76 Ländern. In diesen Ländern gibt es durchschnittlich 64 Millionen Feuerwehreinsätze und 3,8 Millionen Brände pro Jahr, bei denen etwa 26 Tausend Menschen sterben und etwa 56 Tausend Menschen verletzt werden.

Abbildung 1.6 zeigt, dass die meisten Anrufe pro 1.000 Einwohner (Durchschnittswerte für den Zeitraum 2019-2023 (**Tabelle 1.7**)) in Finnland, Luxemburg und der Tschechischen Republik zu verzeichnen sind. Umgekehrt sind die meisten Brände pro 1.000 Einwohner (Durchschnittswerte für den Zeitraum 2019-2023, **Tabelle 1.8**) in Zypern, Österreich und Uruguay zu verzeichnen (**Abbildung 1.7**).

Abbildung 1.8 zeigt, dass die meisten Brandtoten pro 100.000 Einwohner (Durchschnittswerte für 2019-2023, **Tabelle 1.9**) in Belarus, Russland und der Ukraine auftreten. **Abbildung 1.9** zeigt die Verteilung der Brandtoten pro 100 Brände (Durchschnittswerte für 2019-2023, **Tabelle 1.9**).

Abbildung 1.10 zeigt, dass die meisten Brandverletzungen pro 100 Tausend Einwohner (Durchschnittswerte für 2019-2023, **Tabelle 1.10**) in Frankreich, Lettland und Portugal auftreten. **Abbildung 1.11** zeigt die Verteilung der Brandverletzungen pro 100 Brände (Durchschnittswerte für 2019-2023, **Tabelle 1.10**).

Die Tabellen 1.11-1.12 enthalten Daten über die Todesfälle und Verletzungen von Feuerwehrleuten in 26 Ländern. Im Jahr 2023 starben 92 Feuerwehrleute und 64.000. wurden in diesen Ländern verletzt.

Tabelle 1.13 und **die Abbildungen 1.12-1.14** zeigen den Personalbestand der Feuerwehren in 65 Ländern zu Beginn des 21. Jahrhunderts. Aus **Tabelle 1.13** ergibt sich, dass 3,2 Milliarden Einwohner dieser Länder von 15,4 Millionen Feuerwehrleuten, davon 13,8 Millionen Freiwillige, vor Bränden geschützt werden.

Die Tabellen 1.14 und **1.15** enthalten Daten über die Verteilung der Feuerwehrleute nach Geschlecht in 45 Ländern.

Tabelle 1.15 enthält Daten über die Zahl der jungen Feuerwehrleute in 20 Ländern.

Die Tabellen 1.16 und **1.16** zeigen die Verteilung der Brände nach Brandursachen. Die Hauptursachen sind Unachtsamkeit – 27 %, Kamin, Kochstätten – 11 % und Ausfall von elektrischen Geräten – 16 %.

Die Abbildungen 1.17-1.18 zeigen die Verteilung der Opfer, die nach Angaben der Weltgesundheitsorganisation (WHO) im Jahr 2019 an "Feuer, Hitze und heißen Substanzen" starben.

2. Städte der Welt

Aus **Tabelle 2.1** geht hervor, dass in den 25 untersuchten Städten im Jahr 2023 auf 1.000 Einwohner 27,9 Feuerwehreinsätze kamen, davon 2,2 Brände. Weiter weist die Tabelle aus, dass im Jahr 2023 in allen in der Tabelle aufgeführten Städten durchschnittlich 0,6 Menschen pro 100.000 Einwohner starben und 2,4 Menschen pro 100.000 Einwohner bei Bränden verletzt wurden.

Die Abbildungen 2.1-2.4 zeigen die Verteilung der Städte nach der Anzahl der Feuerwehreinsätze und Brände pro 1.000 Einwohner pro Jahr (Durchschnittszahlen für den Zeitraum 2019-2023, **Tabellen 2.6-2.7**) und der Anzahl der Todesfälle bei Bränden pro 100 Tausend Einwohner und pro 100 Brände pro Jahr (Durchschnittszahlen für den Zeitraum 2019-2023, **Tabelle 2.8**).

Tabelle 2.2 und **Abbildung 2.5** enthalten Daten über die Art der Feuerwehrarbeit in 19 Städten der Welt.

Der Anteil der Brände an der Gesamtzahl der Feuerwehreinsätze lag in 19 Städten bei durchschnittlich 8,6 Prozent. Unfallbearbeitung und technische Hilfe machten 8,1 % aller Anrufe aus; 54,2 % aller Feuerwehreinsätze entfielen auf Fahrten zur medizinischen Versorgung. Fehlalarme machen 24,1 % aller Notrufe aus. Auf alle anderen Tätigkeiten entfielen 5,0 % aller Einsätze.

In **Tabelle 2.3** und **Abbildung 2.6** sind Objekte und Orte des Auftretens von Bränden in 18 Städten der Welt berücksichtigt. Fasst man diese Daten zusammen, so zeigt sich, dass 34,9 % aller Brände in Gebäuden (einschließlich Kamine, Schornsteine) (20,9 % in Wohngebäuden und 14,0 % in allen anderen Gebäuden) und 8,0 % im Verkehr (d. h. mehr als 43 % aller Brände entweder in Gebäuden oder in Fahrzeugen auftraten); Waldbrände, Müll, Mülldeponien, Gras und Büsche machten 27,2 % aller Brände aus.

Die Tabellen 2.4 und **2.5** sowie die **Abbildungen 2.7** und **2.8** zeigen die Verteilung der bei Bränden getöteten und verletzten Menschen nach Einwohnerzahl in 13 Städten auf der ganzen Welt.

Sie zeigen, dass 76,43 % der Todesfälle und 70,5 % der Verletzungen in Wohngebäuden auftraten. 91,7% der Toten und 95,3% der Verletzungen ereigneten sich in allen Gebäuden.

Tabelle 2.6 zeigt die Art der Einsatzarten für den Zeitraum 2019-2023 in 49 Städten auf der ganzen Welt. Diese Städte haben 210 Millionen Einwohner und verzeichnen jährlich durchschnittlich 4,7 Millionen Feuerwehreinsätze pro Jahr (d.h. 22,4 Einsätze pro 1.000 Einwohner).

Tabelle 2.7 zeigt die Anzahl der Brände in 56 Städten auf der ganzen Welt im Zeitraum 2019-2023. Sie haben 305 Millionen Einwohner, und es werden jährlich durchschnittlich 295 Tausend Brände pro Jahr registriert (d. h. 1,0 Brand pro 1.000 Einwohner).

Tabelle 2.8 zeigt die Zahl der Brandtoten von 2019 bis 2023 in 51 Städten auf der ganzen Welt. Zweihundertneunundsiebzig Millionen Menschen leben in ihnen, und jährlich sterben durchschnittlich 1.434 Menschen bei Bränden, d.h. auf 100.000 Menschen kamen im Durchschnitt 0,5 Brandtote.

Tabelle 2.9 und **die Abbildungen 2.9-2.12** enthalten Daten über die Zahl der Feuerwehrleute und ihrer technischen Ausrüstung zu Beginn des 21. Jahrhunderts für 77 Städte. In diesen Städten leben mehr als 330 Millionen Menschen. Sie wurden von etwa 246.000 Feuerwehrleuten beschützt. Darunter waren durchschnittlich 1 Berufsfeuerwehrmann pro 1.647 Einwohner (**Abbildung 2.9**) und 17 km² pro Feuerwache (**Abbildung 2.12**). Diese Daten dürften für Spezialisten von einigem Interesse sein.

Acknowledgement

The authors of the report thank the National Committees of CTIF, who sent us the fire statistics for 2023 for analysis.

Now the Center of Fire Statistics of CTIF begins work on report №31. We ask all National Committees of CTIF to send us fire statistics of the countries and cities for the year 2024 **before May 1, 2026**.

The report's authors are always grateful for any suggestions to improve the work of the Center for Fire Statistics.

Conclusión

Los autores del informe agradecen a los Comités Nacionales del CTIF, que enviaron las estadísticas de incendios de 2023 para su análisis.

Ahora el Centro de Estadísticas de Incendios de CTIF comienza a trabajar en el informe Nº31. Pedimos a todos los Comités Nacionales de CTIF que nos envíen las estadísticas de incendios de los países y ciudades del mundo para el año 2024 **antes del 1º de mayo de 2026**.

Los autores del informe están siempre agradecidos por cualquier sugerencia para mejorar el trabajo del Centro de Estadísticas de Incendios.

Zusammenfassung

Die Autoren des Berichtes danken den Nationalen CTIF-Komitees für die Übersendung der Feuerwehrstatistik aus 2023.

Gegenwärtig beginnt das CFS CTIF die Arbeiten am Bericht №31. Wir bitten die Nationalen CTIF-Komitees um Übersendung der nationalen Feuerwehrstatistiken für das Jahr 2024 bis zum 1**. Mai 2026**.

Die Autoren sind wie immer für jeden Hinweis, Kritiken und Vorschläge zur Verbesserung der internationalen Feuerwehr Statistik dankbar.

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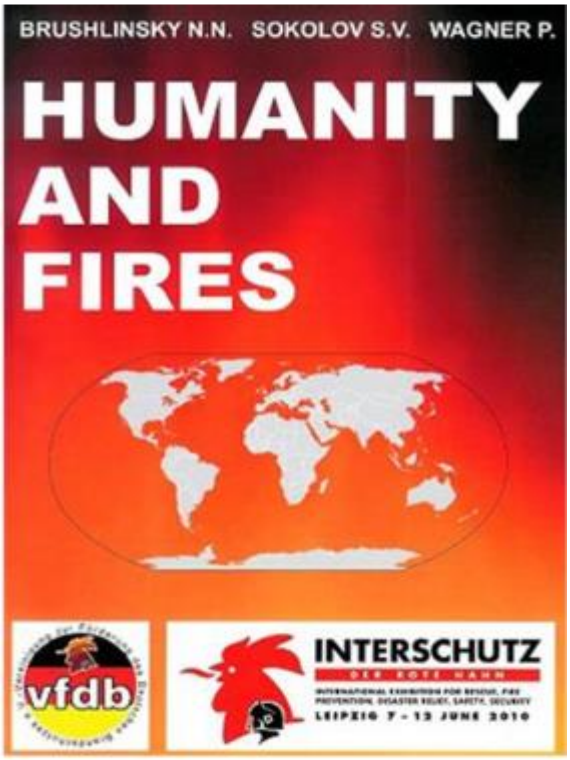
Publications of the CTIF Centre for Fire Statistics on the topics of fire statistics and fire risks can be find in the following books

Publicaciones del Centro CTIF para Estadísticas de Incendios sobre temas de estadísticas de incendios y riesgos de incendios se pueden encontrar en los siguientes libros



Titel: Humanity and Fires
Author(s): Brushlinský N., Sokolov S., Wagner P.
Publisher: EDURA (Poland),
Publication date: 2010
Number of pages: 500
Language: English
ISBN: 978-83-88777-29-5
About: On the occasion of INTERSCHUTZ 2010 in Leipzig (Germany), the book gives an overview of the current fire protection problems in the world at the end of the 20th century. The fire hazards are defined. In addition, an overview of the development of fire risks in 70 countries around the world is given. In the last part of the book, the problems of urbanization, geophysical and other aspects of fire protection are discussed. The book concludes with a reconstruction of the fire hazards up to the year zero of our era and gives an outlook on the 24th century.
Note: Some copies of this publication are available from CTIF's Fire Statistics

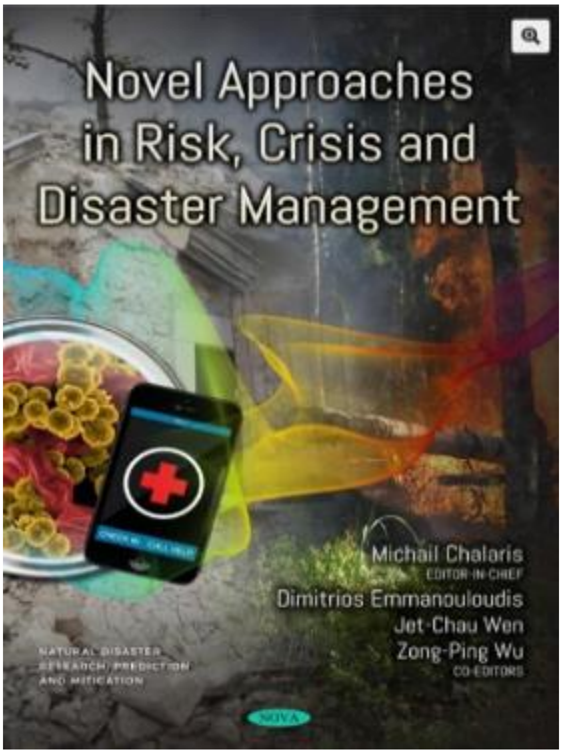
Título: Humanidad e Incendios
Autor(es): Brushlinský N., Sokolov S., Wagner P.
Editorial: EDURA (Polonia)
Fecha de publicación: 2010
Número de páginas: 500
Idioma: Inglés
ISBN: 978-83-88777-29-5
Acerca de: Con motivo de INTERSCHUTZ 2010 en Leipzig (Alemania), el libro ofrece una visión general de los problemas actuales de protección contra incendios

en el mundo a finales del siglo XX. Los peligros de incendio están definidos. Además, se ofrece una visión general del desarrollo de los riesgos de incendio en 70 países de todo el mundo. En la última parte del libro, se discuten los problemas de urbanización, geofísica y otros aspectos de la protección contra incendios. El libro concluye con una reconstrucción de los riesgos de incendio hasta el año cero de nuestra era y ofrece una perspectiva del siglo XXIV. Nota: Algunas copias de esta publicación están disponibles en el Centro de Estadísticas de Incendios del CTIF. Por favor, contáctenos: Correo electrónico: drpeterwagner@freenet.de.

Titel: Red Book of Fires. Selected problems of fires and their effects. Edition 2 (Czerwona Księga Pożarów. Wybrane problemy pożarów oraz ich skutków. Tom 2)
Editor: Piotr Guzewski, Dariusz Wróblewski, Daniel Małozięć
Author(s): N.N. Bruschlinsky, S.V. Sokolov, P. Wagner
Publisher: CNBOP-PIB, Józefów, Poland
Publication date: 2014
Number of pages: 592
Language: Polish
ISBN: 978-83-61520-87-0
About: A large number of current problems of modern fire protection are discussed. CTIF Statistics center contributions in this book in Chapter 3: Fire Risk And Prevention In Nowadays And Forecast For The Future.

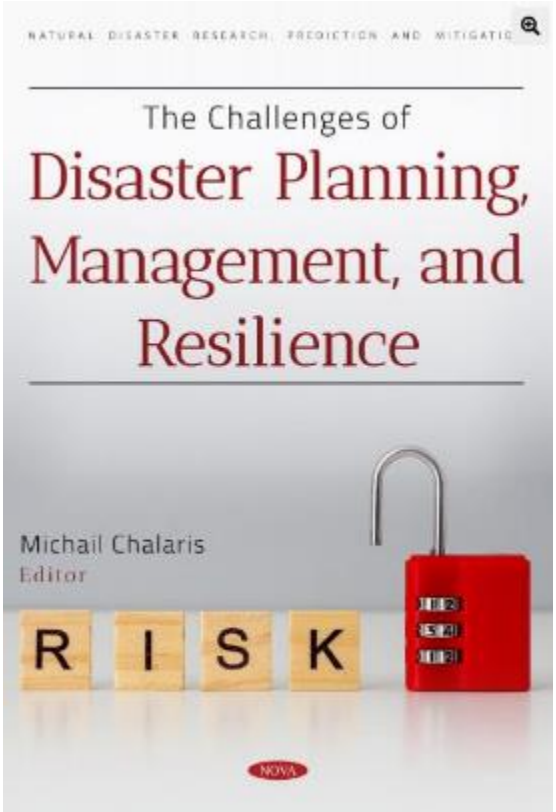
Título: Libro Rojo de los Fuegos. Problemas seleccionados de los incendios y sus efectos. Edición 2 (El Libro Rojo de los Fuegos. Problemas seleccionados de los incendios y sus efectos. Volumen 2)
Montaje: Piotr Guzewski, Dariusz Wróblewski, Daniel Małozięć
Autor(es): N.N. Bruschlinsky, S.V. Sokolov, P. Wagner
Editorial: CNBOP-PIB, Józefów, Polonia
Fecha de publicación: 2014
Número de páginas: 592
Idioma: Polaco
ISBN: 978-83-61520-87-0

Acerca de: Se discute una gran cantidad de problemas actuales de la protección moderna contra incendios. Las contribuciones del Centro de Estadísticas de CTIF en este libro en el Capítulo 3: Riesgo y prevención de incendios en la actualidad y pronóstico para el futuro.



Titel: Novel Approaches in Risk, Crisis and Disaster Management, Reihe: Natural Disaster Research, Prediction and Mitigation
Editor(s): M. Chalaris, D. Emmanouloudis, Jet-
Chau Wen, Z-P. Wu
Author(s): N.N. Bruschlinsky, S.V. Sokolov, P. Wagner
Publisher: Nova Science Publishers, New York, USA
Publication date: 2018
Number of pages: 440
Language: English
ISBN: 978-1-53613-239-7
About: Today, governments are often faced with crises that are so unpredictable (e.g., the attacks of September 11, 2001), so unexpected in their nature or scale (e.g., the SARS and H1N1 pandemic outbreaks, the Indian Ocean tsunami, or Hurricane Katrina), and with such far-reaching social and economic impacts that they seem almost impossible to overcome. Nevertheless, it is possible to successfully overcome these forms of crisis. As previous experience has shown, success in limiting the impact of major hazards on people and property depends not only on the active participation and effective coordination of a wide range of actors at different levels of government administration, but also on preparation and the ability to respond quickly, efficiently and effectively to unexpected events. It is crucial for the success of such an undertaking that national authorities have the right technical tools (reformed risk, crisis and disaster management systems, as well as an appropriate institutional framework) for disaster management. However, as this book aims to show, human capital remains the most important factor in this equation.
The CTIF Center for Fire Statistics has contributed the following chapters to this book: Chapter 1: Problems of Fire Protection in the Modern World (pp. 1-66), Chapter 7: Modelling the Process of Fire and Rescue Services Activities (pp. 181-304).

Título: Enfoques Noveles en Gestión de Riesgos, Crisis y Desastres, Serie: Investigación, Predicción y Mitigación de Desastres Naturales
Editor(es): M. Chalaris, D. Emmanouloudis, Jet-Chau Wen, Z-P. Wu
Autor(es): N.N. Bruschlinsky, S.V. Sokolov, P. Wagner
Editorial: Nova Science Publishers, Nueva York, EE. UU.
Fecha de publicación: 2018
Número de páginas: 440
Idioma: Inglés
ISBN: 978-1-53613-239-7
Acerca: Hoy en día, los gobiernos se enfrentan a menudo a crisis que son tan impredecibles (por ejemplo, los ataques del 11 de septiembre de 2001), tan inesperadas en su naturaleza o escala (por ejemplo, los brotes de pandemia de SARS y H1N1, el tsunami del Océano Índico o el huracán Katrina), y con impactos sociales y económicos tan amplios que parecen casi imposibles de superar. Sin embargo, es posible superar con éxito estas formas de crisis. Como ha demostrado la experiencia previa, el éxito en limitar el impacto de los grandes peligros en las personas y la propiedad no depende solo de la participación activa y la coordinación efectiva de una amplia gama de actores en diferentes niveles de la administración gubernamental, sino también de la preparación y la capacidad de responder rápida, eficiente y efectivamente a eventos inesperados. Es crucial para el éxito de tal empresa que las autoridades nacionales tengan las herramientas técnicas adecuadas (sistemas reformados de gestión de riesgos, crisis y desastres, así como un marco institucional apropiado) para la gestión de desastres. Sin embargo, como este libro pretende mostrar, el capital humano sigue siendo el factor más importante en esta ecuación. El Centro de Estadísticas de Incendios del CTIF ha contribuido con los siguientes capítulos a este libro: Capítulo 1: Problemas de Protección contra Incendios en el Mundo Moderno (pp. 1-66), Capítulo 7: Modelización del Proceso de Actividades de Servicios de Bomberos y Rescate (pp. 181-304).



Titel: The Challenges of Disaster Planning, Management, and Resilience
Editor: M. Chalaris
Author(s): S.V. Sokolov, P. Wagner
Publisher: Nova Science Publishers, New York, USA
Publication date: 2023
Number of pages: 587
Language: English
ISBN: 979-8886972290
About: Major disasters, both natural and man- made, have led to an increased need to improve the effectiveness of existing prevention, mitigation, and response capabilities. The types of disasters that many countries face depend to some extent on their geography and climate, and as a result, they have built different response strategies. There is evidence of a growing vulnerability to disasters as the worsening conditions of climate change may increase the destruction of human life, ecosystems, and infrastructures. This book aims to explore and analyze different approaches and practices in dealing with both traditional and novel forms of resilience and crisis and suggest a way forward for science based on correct decision-making at different levels. CTIF contributions in this book in Chapter 16. 100 Years – 100 Cities: Evaluation of Urban Fire Risks.

Título: Los Desafíos de la Planificación, Gestión y Resiliencia ante Desastres.
Editor: M. Chalaris
Autor(es): S.V. Sokolov, P. Wagner
Editorial: Nova Science Publishers, Nueva York, EE. UU.
Fecha de publicación: 2023
Número de páginas: 587
Idioma: Inglés
ISBN: 979-8886972290
Acerca: Los grandes desastres, tanto naturales como provocados por el hombre, han dado lugar a una mayor necesidad de mejorar la eficacia de las capacidades existentes de prevención, mitigación y respuesta. Los tipos de desastres a los que se enfrentan muchos países dependen en cierta medida de su geografía y clima y, como

resultado, han construido diferentes estrategias de respuesta. Existe evidencia de una creciente vulnerabilidad a los desastres, ya que el empeoramiento de las condiciones del cambio climático puede aumentar la destrucción de la vida humana, los ecosistemas y las infraestructuras. Este libro tiene como objetivo explorar y analizar diferentes enfoques y prácticas para hacer frente a las formas tradicionales y novedosas de resiliencia y crisis, y sugerir un camino a seguir para la ciencia basado en la toma de decisiones correctas a diferentes niveles. Contribuciones de CTIF en este libro en el Capítulo 16. 100 Años – 100 Ciudades: Evaluación de Riesgos de Incendios Urbanos.

Table 1 for filling / Cuadro para completar / Tabelle zum Ausfüllen

Statistical data		Name of country:	Name of capital / largest city:
Population (1,000 inhabitants)			
Area (sq.km.)			
Total number of calls a year:			
-fires			
-rescue, technical aid.			
-medical aid			
-false calls			
-other calls			
Total number of fires:			
structure	- residential (with chimneys)		
	- all other buildings		
-vehicle			
-forests			
-grass, bushes…			
-rubbish			
-other fires			
Number of fire deaths:			
structure	- residential (with chimneys)		
	- all other buildings		
-vehicle			
-other			
Number of fire injuries:			
structure	- residential (with chimneys)		
	- all other buildings		
-vehicle			
-other			
Number of fires by fire cause:			
- electricity Equipment Failure			
- gas Equipment Failure			
- playing with fire			
- fireplace, stove			
- carelessness			
- smoking			
- arson			
- other causes			
-			
Number of fires by means of their extinguishing:			
- before arrival of fire units			
- small equipment’s			
- 1-jet			
- 2-3 jets			
- more than 3 jets			
- foam jets			
- powder jets			

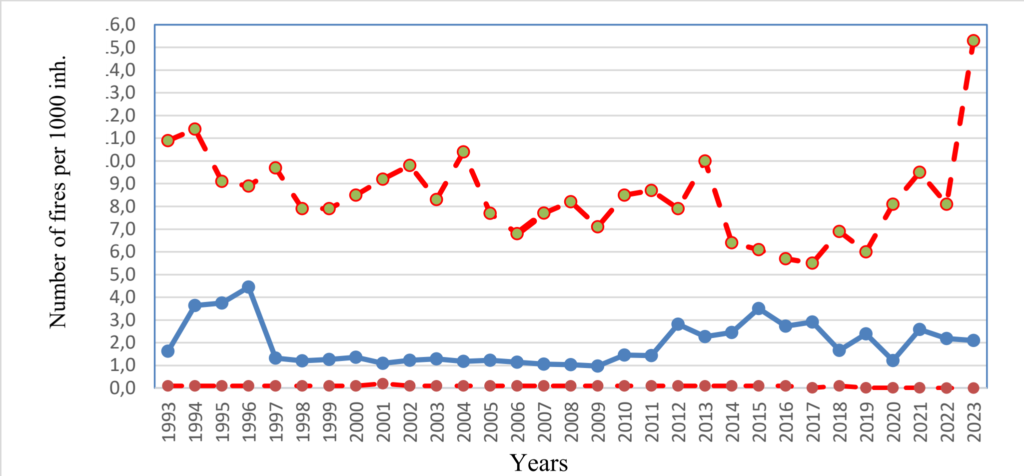
Statistical data	Name of country:	Name of capital / largest city:
Number of firefighter deaths		
Number of firefighter injuries		
Number of all firefighters:		
-professionals (full time)		
-part time		
-volunteers		
Number of female firefighters:		
-professionals (full time)		
-part time		
-volunteers		
Number of young (junior) firefighters:		
Number of fire stations		
Number of fire engines (pumpers)		
Number of ladders and hydraulic lifts		
Number of other fire automobile		

Table/Cuadro/Tabelle 1.1

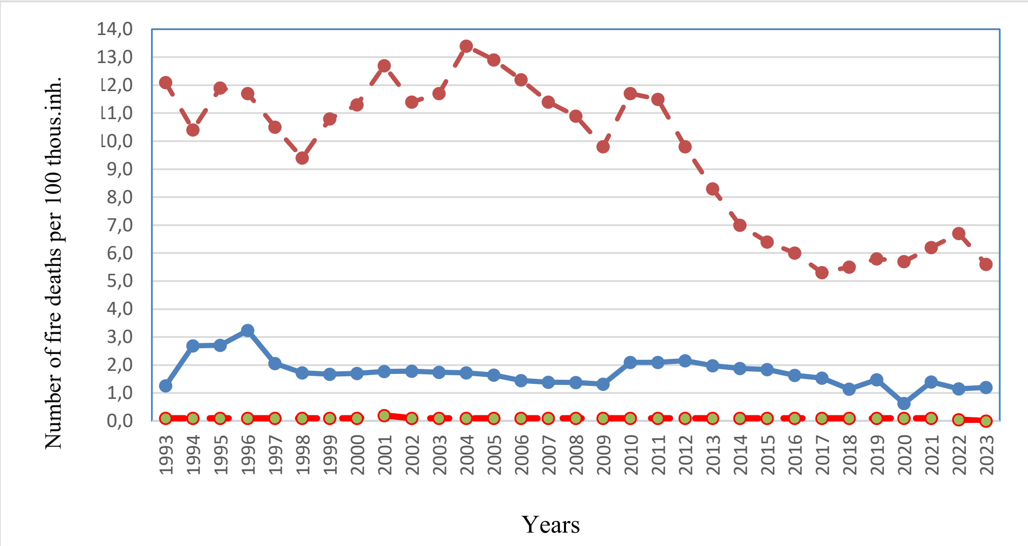
Total reported fire statistical data, by country, 1993-2023
Datos estadísticos reportados, por país, 1993-2023
Verdichtete Daten zur Brandsituation der Staaten in den Jahren 1993-2023

Year	Number of countries	Total population, bln.inh.	Number of fires, mln.	Number of fire deaths, thous.	Average number of fires per 1.000 inh.	Average number of fire deaths	
						per 100,000 inh.	per 100 fires
Año	Cantidad of paises	Población total en Miles de Mill.	Total de incendios en mill.	Número de víctimas fatales x 1.000	Promedio de incendios por 1.000 hab.	Promedio de víctimas fatales	
						por 100,000 habitantes	por cada 100 incendios
Jahr	Anzahl der Staaten	Gesamt-bevölkerung in Mrd.	Anzahl der Brände in Mio.	Anzahl der Brandtoten in 1.000	Mittelwert der Brandanzahl je 1.000 Einw.	Mittelwert der Brandtotenanzahl	
						je. 100.000 Einw.	je 100 Brände
1993	39	2,4	3,9	30,2	1,6	1,3	0,8
1994	27	1,1	4,0	29,5	3,6	2,7	0,7
1995	42	1,2	4,5	32,5	3,8	2,7	0,7
1996	43	0,9	4,0	29,1	4,4	3,2	0,7
1997	48	2,8	3,7	57,7	1,3	2,1	1,6
1998	47	3,0	3,6	51,7	1,2	1,7	1,4
1999	52	3,1	3,9	51,8	1,3	1,7	1,3
2000	57	3,3	4,5	56,2	1,4	1,7	1,2
2001	46	3,5	3,8	61,9	1,1	1,8	1,6
2002	41	3,5	4,3	62,3	1,2	1,8	1,4
2003	39	3,5	4,5	61,1	1,3	1,7	1,4
2004	44	3,5	4,1	60,1	1,2	1,7	1,5
2005	45	3,5	4,3	57,4	1,2	1,6	1,3
2006	37	3,6	4,1	52,2	1,1	1,5	1,3
2007	40	3,8	4,0	52,5	1,1	1,4	1,3
2008	31	3,5	3,6	48,3	1,0	1,4	1,3
2009	31	3,4	3,3	44,7	1,0	1,3	1,4
2010	33	2,2	3,2	46,1	1,5	2,1	1,4
2011	34	2,3	3,3	48,2	1,4	2,1	1,5
2012	35	1,1	3,1	23,7	2,8	2,2	0,8
2013	31	1,1	2,5	21,7	2,3	2,0	0,9
2014	32	1,1	2,7	20,7	2,5	1,9	0,8
2015	31	1,0	3,5	18,4	3,5	1,8	0,5
2016	39	1,1	3,0	18,0	2,7	1,6	0,6
2017	34	1,1	3,2	16,9	2,9	1,5	0,5
2018	46	2,7	4,5	30,8	1,7	1,1	0,7
2019	34	1,3	3,1	19,2	2,4	1,5	0,6
2020	48	3,3	4,0	20,7	1,2	0,6	0,5
2021	38	1,2	3,1	16,8	2,6	1,4	0,5
2022	55	1,7	3,7	19,6	2,2	1,2	0,5
2023	44	1,5	3,0	17,4	2,0	1,2	0,6
ẋ	**40**	**2,3**	**3,7**	**38,0**	**1,6**	**1,6**	**1,0**
∑			**114,0**	**1177,4**			

a)



b)



c)

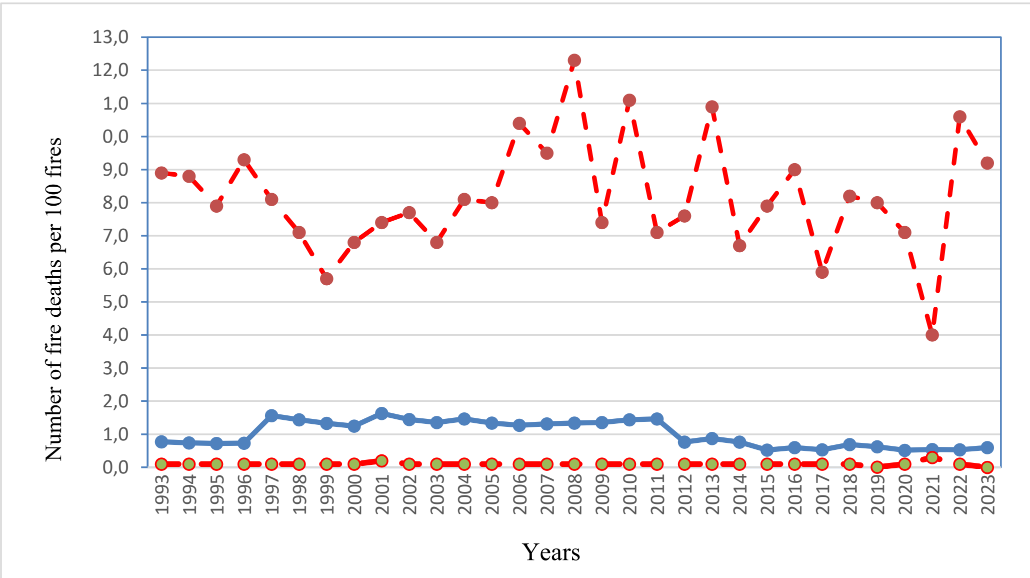


Fig. 1.1: Trends in a) number of fires per 1000 inh.; b) number of fire deaths per 100 thous.inh.; c) number of fire deaths per 100 fires (Table 1.1)
Fig. 1.1: Tendencias en a) número de incendios por cada 1000 habitantes; b) número de muertes por incendios por cada 100 mil habitantes; c) número de muertes por incendios por cada 100 incendios (Tabla 1.1)
Bild 1.1: Trends a) Anzahl der Brände pro 1000 Einwohner; b) Anzahl der Brandtoten pro 100.000 Einwohner; c) Anzahl der Brandtoten pro 100 Brände (Tabelle 1.1)

Table/Cuadro/Tabelle 1.2

Common indicators of fire statistics in the countries of the World in 2023
Datos estadísticos reportados, por país, año 2023
Verdichtete Kennzahlen der Brandsituation in den Staaten für das Jahr 2023

№	Country	Population, thous.inh.	Number of				Average number:					
			calls	fires	fire deaths	fire injuries	per 1000 inh.:		fire deaths per:		fire injuries per:	
							calls	fires	100000 inh.	100 fires	100000 inh.	100 fires
	País	Habitantes, en miles	Número de				Promedios:					
			Llamados	Incendios	Víctimas Fatales	Lesionados	Por 1.000 hab.		Víctimas fatales		Lesionados	
							Llamados	Incendios	100.000 hab.	100 incendios	100.000 hab.	100 incendios
	Staat	Einwohner, in 1000	Absolute Anzahl				Mittelwerte:					
			Einsätze	Brände	Brand-tote	Verletzte	je 1000 Einw.		Brandtotenzahl		Verletztenzahl	
							Einsätze	Brände	100000 Einw.	100 Brände	100000 Einw.	100 Brände
1	USA	336 806	42 412 500	1 388 500	3 070	11 990	125,9	4,1	0,91	0,22	3,6	0,9
2	Russia	146 781	-	360 962	7 825	8 506	-	2,5	5,33	2,17	5,8	2,4
3	Philippines	117 340	-	16 433	321	1 050	-	0,1	0,27	1,95	0,9	6,4
4	Egypt	112 717	-	45 435	239	812	-	0,4	0,21	0,53	0,7	1,8
5	Vietnam	100 352	-	3 562	157	136	-	0,0	0,16	4,41	0,1	3,8
6	Great Britain	66 344	719 015	216 763	309	6 339	10,8	3,3	0,47	0,14	9,6	2,9
7	France	66 309	4 771 900	277 100	-	-	72,0	4,2	-	-	-	-
8	Myanmar	54 580	-	1 362	77	193		0,0	0,14	5,65	0,4	14,2
9	Korea (South)	51 774	-	38 857	283	2 194	-	0,8	0,55	0,73	4,2	5,6
10	Poland	37 766	-	99 205	482	-	-	2,6	1,28	0,49	-	-
11	Ukraine	37 441	178 155	68 549	1 468	1 538	4,8	1,8	3,92	2,14	4,1	2,2
12	Uzbekistan	36 800	-	10 204	79	172		0,3	0,21	0,77	0,5	1,7
13	Malaysia	34 309	129 114	34 389	-	-	3,8	1,0	-	-	-	-
14	Ghana	34 121	-	5 973	263	2 557	-	0,2	0,77	4,40	7,5	42,8
15	Taiwan	23 420	-	17 466	193	363	-	0,7	0,82	1,11	1,5	2,1
16	Kazakhstan	20 333	55 000	11 805	344	311	2,7	0,6	1,69	2,91	1,5	2,6
17	Romania	19 053	-	31 204	286	-	-	1,6	1,50	0,92	-	-
18	Cambodia	16 940	-	761	54	97	-	0,0	0,32	7,10	0,6	12,7
19	Belgium	11 697	182 438	30 885	27	395	15,6	2,6	0,23	0,09	3,4	1,3
20	Jordan	11 516	531 769	33 940	54	1 720	46,2	2,9	0,47	0,16	14,9	5,1
21	Czech Republic	10 827	3 175 345	34 226	105	1 410	293,3	3,2	0,97	0,31	13,0	4,1
22	Greece	10 788	85 098	28 303	59	90	7,9	2,6	0,55	0,21	0,8	0,3
23	Sweden	10 552	119 295	22 881	103	738	11,3	2,2	0,98	0,45	7,0	3,2
24	Tadjikistan	10 160	-	1 236	23	-	-	0,1	0,23	1,86	-	-
25	Azerbaijan	10 154	-	1 907	40	169	-	0,2	0,39	2,10	1,7	8,9
26	Portugal	9 857	1 575 224	28 350	37	1 325	159,8	2,9	0,38	0,13	13,4	4,7
27	UAE	9 517	-	2 473	16	9	-	0,3	0,17	0,65	0,1	0,4
28	Belarus	9 408	-	5 677	524	535	-	0,6	5,57	9,23	5,7	9,4
29	Austria	9 158	303 666	66 354	60	-	33,2	7,2	-	-	-	-
30	Kyrgyzstan	6 735	-	3 498	35	29	-	0,5	0,52	1,00	0,4	0,8
31	Bulgaria	6 731	64 970	33 974	113	289	9,7	5,0	1,68	0,33	4,3	0,9
32	Denmark	5 944	39 921	11 183	50	-	6,7	1,9	0,84	0,45	-	-
33	Singapore	5 920	246 832	1 954	3	81	41,7	0,3	0,05	0,15	1,4	4,1
34	New Zealand	5 123	92 509	17 230	17	264	18,1	3,4	0,33	0,10	5,2	1,5
35	Ireland	5 033	122 449	17 790	17	-	24,3	3,5	0,34	0,10	-	-
36	Croatia	3 860	45 918	10 414	21	166	11,9	2,7	0,54	0,20	4,3	1,6
37	Georgia	3 736	-	10 564	48	205	-	2,8	1,28	0,45	5,5	1,9
38	Uruguay	3 499	32 288	24 701	157	422	9,2	7,1	4,49	0,64	12,1	1,7
39	Moldova	3 435	-	1 666	121	-	-	0,5	3,52	7,26	-	-
40	Jamaica	2 827	20 152	11 389	27	66	7,1	4,0	0,96	0,24	2,3	0,6
41	Lithuania	2 805	30 106	9 289	100	186	10,7	3,3	3,57	1,08	6,6	2,0
42	Latvia	1 830	16 136	6 401	68	257	8,8	3,5	3,72	1,06	14,0	4,0
43	Estonia	1 365	30 674	3 240	35	70	22,5	2,4	2,56	1,08	5,1	2,2
44	Mauritius	1 260	10 617	4 770	7	29	8,4	3,8	0,56	0,15	2,3	0,6
45	Bhutan	786	-	142	-	-	-	0,2	-	-	-	-
46	Guam	155	17 703	2 364	0	-	114,2	15,3	0,00	0,00	-	-
	∑	**1 509 314**	**55 076 604**	**3 085 306**	**17 421**	**45 047**	**36,5**	**2,0**	**1,15**	**0,56**	**3,0**	**1,5**

Table/Cuadro/Tabelle 1.3

Type of fire service calls in the countries of the World in 2023
Tipo de llamado, por país, año 2023
Struktur der Feuerwehreinsätze in den Staaten im Jahr 2023

№	Country / País / Staat	Population thous.inh. / Habitantes, en miles / Einwohner in 1000	Number of calls / Cantidad de llamados … / Anzahl der Einsätze …									
			fires / Incendios / zu Bränden	in % / en % / in %	accidents* / Accidentes* / zu Havarien	in % / en % / in %	medical aid / Asistencia médica / Medizin. Hilfe	in % / en % / in %	false calls / Falsas alarmas / Fehl-einsätze	in % / en % / in %	other / Otros / Sonstiges	in % / en % / in %
1	USA	336 806	1 389 000	3,4	2 733 500	6,6	24 405 000	59,3	3 140 000	7,6	9 479 000	23,0
2	France	66 309	277 100	5,6	271 642	5,4	4 083 200	88,2	-	-	355 000	7,1
3	Ukraine	37 441	68 549	38,5	43 804	24,6	-	-	9 207	5,2	56 595	31,8
4	Belgium	11 697	30 885	16,9	126 531	69,4	-	-	25 022	13,7	-	-
5	Jordan	11 516	33 940	6,3	36 861	6,8	460 968	85,6	6 580	1,2	0	0,0
6	Czech Republic	10 827	34 226	1,1	130 936	4,1	171 179	5,4	2 747 245	86,5	91 732	2,9
7	Greece	10 788	28 303	33,3	24 636	29,0	-	-	9 742	11,4	22 417	26,3
8	Sweden	10 552	22 881	19,2	27 790	23,3	14 187	11,9	45 901	38,5	8 536	7,2
9	Portugal	9 857	28 350	1,8	49 839	3,2	1 156 025	73,4	10 174	0,6	330 836	21,0
10	Austria	9 158	66 354	20,8	212 141	66,4	-	-	15 930	5,0	25 171	7,9
11	Bulgaria	6 731	33 944	52,3	16 561	25,5	271	0,4	1 966	3,0	12 198	18,8
12	Denmark	5 944	11 183	28,0	962	2,4	-	-	21 681	54,3	6 095	15,3
13	Singapore	5 920	1 954	0,8	9 208	3,6	183 175	71,5	6 285	2,5	55 418	21,6
14	New Zealand	5 123	17 230	21,2	10 327	12,7	16 292	20,0	36 456	44,8	1 088	1,3
15	Ireland	5 033	17 790	14,5	15 818	12,9	81 349	66,4	7 492	6,1	-	-
16	Croatia	3 860	10 414	22,7	30 650	66,7	613	1,3	811	1,8	3 430	7,5
17	Uruguay	3 499	24 701	79,7	250	0,8	-	-	981	3,2	5 065	16,3
18	Lithuania	2 805	9 289	30,9	12 805	42,5	0	0,0	135	0,4	7 877	26,2
19	Estonia	1 365	3 240	10,6	11 822	38,5	-	-	10 421	34,0	5 191	16,9
20	Mauritius	1 260	4 770	44,9	5 659	53,3	-	-	188	1,8	0	0,0
	∑	**556 491**	**2 114 103**	**4,0**	**3 771 742**	**7,1**	**30 572 259**	**57,7**	**6 096 217**	**11,5**	**10 465 649**	**19,7**

* - This position includes all kinds of non-fire incidents

Table/Cuadro/Tabelle 1.4

Distribution of fires by types in the countries of the World in 2023
Distribución de tipos de incendios en los países del mundo año 2023
Verteilung der Brände nach Objekten der Brandentstehung in den Staaten im Jahr 2023

№	Country	Population, thous.inh.	Number of fires …															
			structure fires						vehicles	in %	forests	in %	grass, brush	in %	rubbish	in %	other	in %
			residential	in %	others	in %	all	in %										
	País	Habitantes, en miles	Cantidad de incendios …															
			Fuego estructural						Vehículos	%	Forestal	%	Pastizal, Matorral	%	Basura	%	Otros	%
			residencial	%	Otros	%	todos	%										
	Staat	Einwohner in 10000	Anzahl der Brände …															
			in Gebäuden						Transport	in %	im Wald	in %	Gras usw.	in %	Abfall, Müll	in %	Sonstige	in %
			Wohnung	in %	andere	in %	alle	in %										
1	USA	336 806	352 000	25,3	118 000	8,5	470 000	33,8	210 500	15,2	-	-	287 000	20,7	248 500	17,9	173 000	12,5
2	Russia	146 781	110 485	30,1	23 716	6,5	134 201	36,5	-	-	12 241	3,3	-	-	-	-	220 888	60,1
3	Ukraine	37 441	25 540	36,9	2 157	3,1	27 697	40,0	3 615	5,2	1 278	1,8	33 962	49,1	242	0,3	2 418	3,5
4	Kazakhstan	20 333	6 909	50,0	4 467	32,3	11 376	82,3	2 442	17,7	-	-	-	-	-	-	-	-
5	Jordan	11 516	3 809	11,2	2 109	6,2	5 918		1 599	4,7	1 122	3,3	-	-	3 382	10,0	21 889	64,6
6	Czech Republic	10 827	3 390	19,1	1 676	9,4	5 066	28,5	2 447	13,8	1 512	8,5	672	3,8	4 652	26,2	3 409	19,2
7	Greece	10 788	-	-	-	-	4 823	17,0	1 591	5,6	1 535	5,4	7 427	26,2	1 319	4,7	11 607	41,0
8	Sweden	10 552	5 883	25,7	4 481	19,6	10 364	45,3	4 261	18,6	2 629	11,5	2 062	9,0	1 636	7,2	1 929	8,4
9	Portugal	9 857	5 651	19,8	1 376	4,8	7 027	24,7	243	0,9	1 329	4,7	5 983	21,0	6 244	21,9	7 674	26,9
10	Austria	9 104	-	-	-	-	25 565	83,9	2 516	8,3	-	-	2 384	7,8	-	-	-	-
11	Bulgaria	6 731	3 067	9,0	865	2,5	3 932	11,6	1 812	5,3	424	1,2	14 162	41,7	8 610	25,3	5 034	14,8
12	Denmark	5 944	2 734	29,0	2 244	23,8	4 978	52,9	1 055	11,2	116	1,2	1 105	11,7	1 305	13,9	854	9,1
13	Singapore	5 920	970		404		1 374		215		-	-	133		106		126	
14	New Zealand	5 123	-	-	-	-	5 055	29,3	2 442	14,2	-	-	3 228	18,7	3 396	19,7	3 109	18,0
15	Ireland	5 033	4 270	24,0	1 112	6,3	5 382	30,3	1 987	11,2	-	-	1 618	9,1	4 573	25,7	4 230	23,8
16	Croatia	3 860	999	9,6	2940	28,2	3 939	37,8	1 007	9,7	-	-	3 013	28,9	1737	16,7	718	6,9
17	Lithuania	2 805	1 511	19,1	1701	21,5	3 212	40,6	817	10,3	246	3,8	1 463	18,5	1498	19,0	669	8,5
18	Latvia	1 830	1 739	27,2	1 190	18,6	2 929	45,8	706	11,0	-	-	752	11,7	-	-	2 014	31,5
19	Estonia	1 365	616	19,0	373	11,5	989	30,5	320	9,9	858	26,5	-	-	629	19,4	443	13,7
20	Mauritius	1 260	384	8,1	149	3,1	533	11,2	162	3,4	83	1,7	680	14,3	2 083	43,7	1 229	25,8
	∑	**643 876**	**529 957**	**25,5**	**168 960**	**8,1**	**698 917**	**33,6**	**239 737**	**11,5**	**23 373**	**1,1**	**365 644**	**17,6**	**289 912**	**13,9**	**461 240**	**22,2**

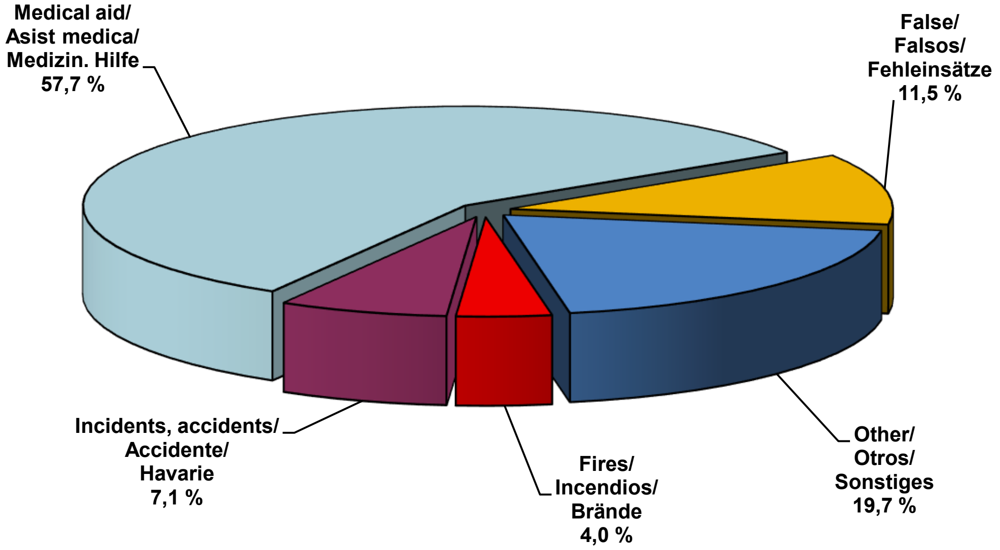


Fig. 1.2: Type of fire service calls in the countries (2023)
Fig. 1.2: Tipo de operaciones en los países (2023)
Bild 1.2: Einsatzstruktur der Feuerwehren in den Staaten (2023)

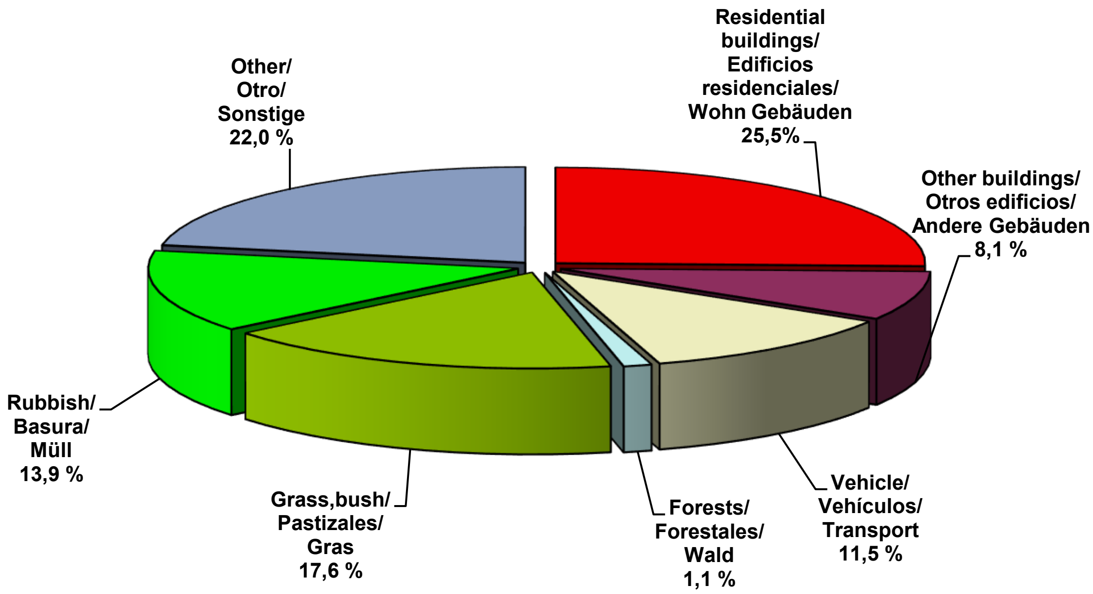


Fig. 1.3: Distribution of fires by types in the countries (2023)
Fig. 1.3: Distribución de incendios en los paíse (2023)
Bild 1.3: Verteilung der Brände nach Objekten der Brandentstehung in den Staaten (2023)

Table/Cuadro/Tabelle 1.5

Distribution of fire deaths by type of fires in the countries of the World in 2023
Distribución de fallecidos según tipo de incendio el países del mundo año 2023
Verteilung der Brändtoten nach Objekten der Brandentstehung in den Staaten im Jahr 2023

№	Country	Population, thous.inh.	Number of fire deaths							
			structure fires				vehicles	in %	other	in %
			residential	in %	all others	in %				
	País	Habitantes, en miles	Muertos en incendios							
			Incendios Estructurales				vehículos	en %	otros	en %
			Residencial	en %	Otros	en %				
	Staat	Einwohner in 10000	Anzahl der Brandtoten							
			in Gebäuden				Transport	in %	Sonstige	in %
			Wohnung	in %	andere	in %				
1	USA	336 806	2 920	79,6	150	4,1	350	9,5	250	6,8
2	Russia	146 781	7 100	90,7	447	5,7	-	-	278	3,6
3	Ukraine	37 441	1 314	89,5	50	3,4	41	2,8	63	4,3
4	Kazakhstan	20 333	181	52,6	163	47,4	0	0,0	0	0,0
5	Jordan	11 516	37	68,5	5	9,3	7	13,0	5	9,3
6	Czech Republic	10 827	45	42,9	14	13,3	21	20,0	25	23,8
7	Sweden	10 552	83	80,6	12	11,7	1	1,0	7	6,8
7	Portugal	9 857	28	75,7	2	5,4	5	13,5	2	5,4
8	Denmark	5 944	49	98,0	0	0,0	1	2,0	0	0,0
10	Ireland	5 033	16	94,1	0	0,0	0	0,0	1	5,9
11	Croatia	3 860	0	0,0	16	76,2	3	14,3	2	9,5
12	Lithuania	2 805	53	53,0	37	37,0	1	1,0	9	9,0
13	Estonia	1 365	34	97,1	1	2,9	0	0,0	0	0,0
	∑	**603 120**	**11 860**	**85,8**	**897**	**6,5**	**430**	**3,1**	**642**	**4,6**

Table/Cuadro/Tabelle 1.6

Distribution of fire injuries by type of fire in the countries of the World in 2023
Distribución de lesionados según tipo de incendio en paises del mundo en 2023
Verteilung der Verletzte nach Objekten der Brandentstehung in den Staaten im Jahr 2023

№	Country	Population, thous.inh.	Number of fire injuries							
			structure fires				vehicles	in %	other	in %
			residential	in %	all others	in %				
	País	Habitantes, en miles	Cantidad de lesionados							
			incendios estructurales				vehículos	en %	otros	en %
			residencial	en %	otros	en %				
	Staat	Einwohner in 10000	Anzahl der Verletzte							
			in Gebäuden				Transport	in %	Sonstige	in %
			Wohnung	in %	andere	in %				
1	USA	336 806	10 490	78,5	1 300	9,7	1 050	7,9	520	3,9
2	Ukraine	37 441	1 183	76,9	76	4,9	127	8,3	152	9,9
3	Kazakhstan	20 333	278	89,4	30	9,6	3	1,0	0	0,0
4	Jordan	11 516	1 157	67,3	283	16,5	101	5,9	179	10,4
5	Czech Republic	10 827	711	50,4	283	20,1	201	14,3	215	15,2
6	Sweden	10 552	594	80,5	98	13,3	34	4,6	12	1,6
7	Portugal	9 857	839	63,3	192	14,5	56	4,2	238	18,0
8	Hungary	9 765	553	70,2	93	11,8	32	4,1	110	14,0
9	Bulgaria	6 731	195	67,5	15	5,2	14	4,8	65	22,5
10	Croatia	3 860	3	1,8	132	79,5	10	6,0	21	12,7
11	Lithuania	2 805	54	29,0	101	54,3	16	8,6	15	8,1
12	Estonia	1 365	58	82,9	9	12,9	0	0,0	3	4,3
	∑	**461 858**	**16 115**	**73,6**	**2 612**	**11,9**	**1 644**	**7,5**	**1 530**	**7,0**

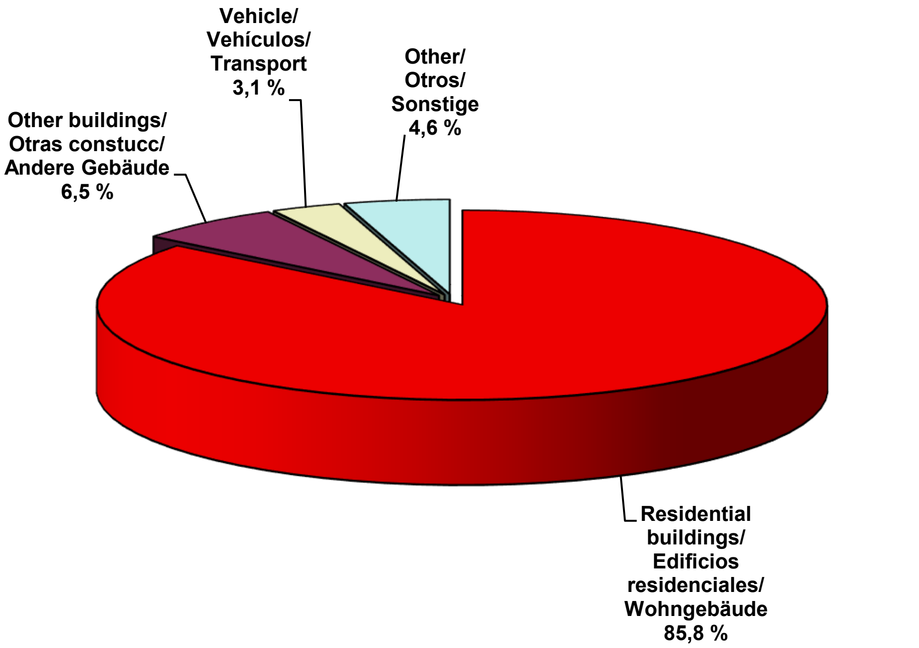


Fig. 1.4: Distribution of fire deaths by types in the counties (2023)
Fig. 1.4: Distribución de fallecidos según tipo de incendio en países (2023)
Bild 1.4: Verteilung der Brandtoten nach Objekten der Brandentstehung in den Staaten (2023)

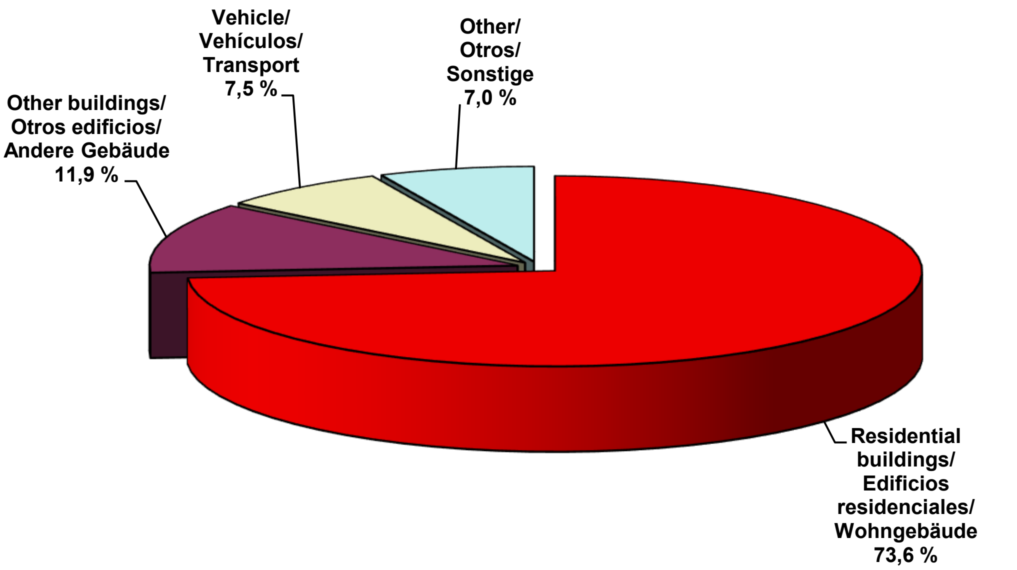


Fig. 1.5: Distribution of fire injuries by types in the countries (2023)
Fig. 1.5: Distribución de lesionados sgún tipo en países (2023)
Bild 1.5: Verteilung der Brandverletzten nach Objekten der Brandentstehung in den Staaten (2023)

Table/Cuadro/Tabelle 1.7

Trends in calls in the countries of the World in 2019-2023
Dinámica en las operaciones en países del mundo para los años 2019-2023
Dynamik der Einsätze in den Staaten der Welt für die Jahre 2019-2023

№	Country	Population, thous. inh.	Number of calls					Average	
			2019	2020	2021	2022	2023	per year	per 1000 inh. a year
	País	Habitantes, en miles	Cantidad de operaciones					Promedio	
			2019	2020	2021	2022	2023	Por año	Por año y 1000 hab
	Staat	Einwohner in 1000	Gesamtanzahl der Einsätze					Mittelwert	
			2019	2020	2021	2022	2023	je Jahr	je Jahr und 1000 Einw.
1	USA	336 806	37 272 000	35 026 000	36 624 000	42 059 500	42 412 500	38 678 800	114,84
2	Bangladesh	171 186	93 844	67 568	-	72 272	-	77 895	0,46
3	Russia	146 781	1 161 581	-	-	-	-	1 161 581	7,91
4	Japan	125 502	8 768 855	7 932 672	8 016 669	-	-	8 239 399	65,65
5	Vietnam	100 300	-	8 046	7 680	11 383	-	9 036	0,09
6	Germany	83 020	4 315 723	4 089 572	4 344 572	-	-	4 249 956	51,19
7	France	67 244	4 819 900	4 290 700	4 680 900	4 968 500	4 771 900	4 706 380	69,99
8	Great Britain	65 185	705 924	685 083	636 088	707 633	719 015	690 749	10,60
9	Italy	60 317	944 332	884 128	912 593	981 579	-	930 658	15,43
10	Korea (South)	51 774	-	11 274 559	-	5 387 921	-	8 331 240	160,92
11	Poland	37 766	512 500	583 300	579 713	608 818	-	571 083	15,12
12	Ukraine	37 441	269 160	279 671	238 121	181 935	178 155	229 408	6,13
13	Malysia	34 309	117 065	124 596	168 206	126 704	129 114	133 137	3,88
14	Peru	32 000	-	115 677	79 535	79 782	-	91 665	2,86
15	Kazakhstan	20 333	63 727	55 102	76 592	55 000	55 000	61 084	3,00
16	Romania	19 053	-	525 916	591 105	-	-	558 511	29,31
17	Ecuador	18 000	-	-	-	46 216	-	46 216	2,57
18	Netherlands	17 591	143 500	-	135 359	-	-	139 430	7,93
19	Belgium	11 697	-	251 551	203 094	245 115	182 438	220 550	18,86
20	Jordan	11 516	364 926	768 030	613 373	525 199	531 769	560 659	48,69
21	Czech Republic	10 827	2 298 681	2 289 149	2 319 720	2 506 162	3 175 345	2 517 811	232,55
22	Greece	10 788	72 545	76 305	76 726	80 546	85 098	78 244	7,25
23	Sweden	10 552	128 044	120 173	-	-	119 295	122 504	11,61
24	Portugal	9 857	-	-	-	1 528 677	1 575 224	1 551 951	157,45
25	Hungary	9 765	79 922	77 328	78 375	92 879	92 879	84 277	8,63
26	Israel	9 656	71 618	65 770	150 137	159 709	-	111 809	11,58
27	Belarus	9 408	81 590	-	-	-	-	81 590	8,67
28	Austria	9 104	278 672	247 436	300 620	266 876	-	273 401	30,03
29	Switzerland	8 703	70 939	70 493	83 970		-	75 134	8,63
30	Paraguay	7 453	-	-	-	36 158	-	36 158	4,85
31	Serbia	6 797	35 068	27 333	30 919	31 246	-	31 142	4,58
32	Bulgaria	6 520	-	56 057	55 059	62 492	-	57 869	8,88
33	Denmark	5 944	39 775	37 496	-	40 152	39 921	39 336	6,62
34	Singapore	5 920	194 330	196 345	213 615	256 837	246 832	221 592	37,43
35	Finland	5 565	-	2 787 190	2 782 980	2 291 400	-	2 620 523	470,89
36	New Zealand	5 123	82 632	83 669	84 688	87 684	92 509	86 236	16,83
37	Norway	5 109	93 768	84 862	90 605	-	-	89 745	17,57
38	Slovakia	5 042	123 484	127 408	1 080 333	-	-	443 742	88,01
39	Ireland	5 033	120 024	114 080	119 092	126 536	122 449	120 436	23,93
40	Panama	4 395	-	-	-	43 759	-	43 759	9,96
41	Croatia	3 860	31 393	37 834	43 843	38 234	45 918	39 444	10,22
42	Uruguay	3 499	-	-	33 173	36 547	32 288	34 003	9,72
43	Mongolia	3 409	4 990	4 006	4 380	4 129	-	4 376	1,28
44	Armenia	2 973	-	10 669	-	-	-	10 669	3,59
45	Jamaica	2 827	14176	12728	11138	-	20 152	14 549	5,15
46	Lithuania	2 805	30 666	29 305	29 779	30 235	30 106	30 018	10,70
47	Slovenia	2 108	-	28 677	24 706	-	-	26 692	12,66
48	Latvia	1 830	20 749	19 124	22 215	20 988	16 136	19 842	10,84
49	Estonia	1 365	26 076	14 879	27 502	27 408	30 674	25 308	18,54
50	Mauritius	1 260	12 134	12 098	10 536	12 483	10 617	11 574	9,19
51	Cyprus	918	-	11 985	12 333	11 247	-	11 855	12,91
52	Luxemburg	602	-	-	229 303	-	-	229 303	380,90
53	Brunei	445	7 218	6 759	-	-	-	6 989	15,70
54	Andorra	78		6 623	-	-	-	6 623	84,91
55	Liechtenstein	39	-	-	6 345	7 314	-	6 830	175,12
	∑	**1 627 400**	**63 471 531**	**73 617 952**	**65 829 692**	**63 857 255**	**54 715 334**	**64 298 353**	**39,51**

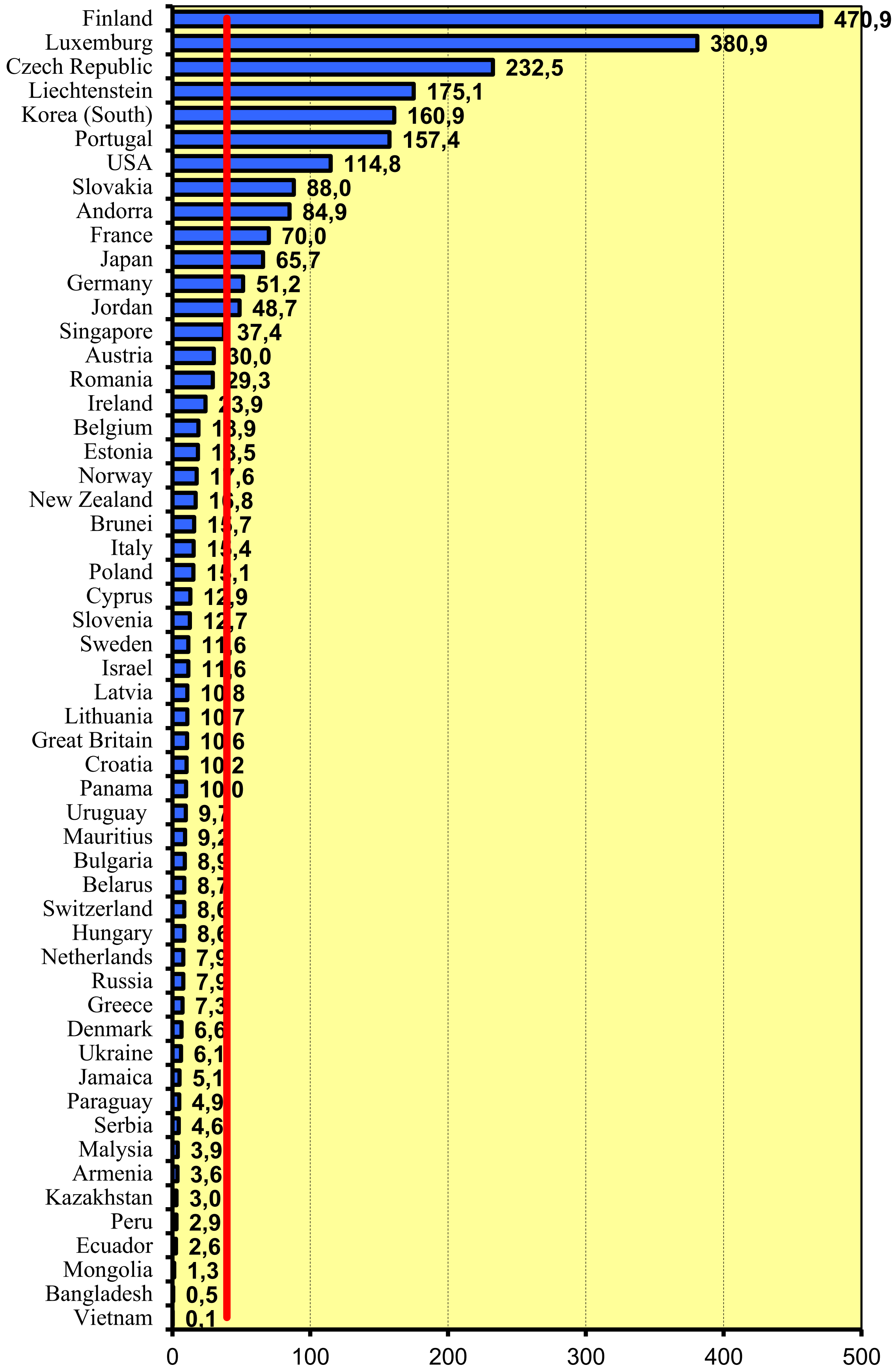


Fig. 1.6: Average number of calls per 1,000 inh. (2019-2023)
Fig. 1.6: Promedio de operaciones por 1.000 hab. (2019-2023)
Bild 1.6: Mittlere Einsatzanzahl je 1.000 Einwohner (2019-2023)

Table/Cuadro/Tabelle 1.8

Trends in fires in the countries of the World in 2019-2023
Dinámica de los incendios en países del mundeo para los años 2019-2023
Dynamik der Brandzahlen in den Staaten der Welt für die Jahre 2019-2023

№	Country	Population, thous. inh.	Number of fires					Average	
			2019	2020	2021	2022	2023	per year	per 1000 inh. a year
	País	Habitantes, en miles	Cantidad de incendios					Promedio	
			2019	2020	2021	2022	2023	Por año	Por año y 1000 hab.
	Staat	Einwohner in 1000	Anzahl der Brände					Mittelwert	
			2019	2020	2021	2022	2023	je Jahr	je Jahr und 1000 Einw.
1	China	1 390 000	255 625	252 000	-	-	-	253 813	0,18
2	USA	336 806	1 291 500	1 388 500	1 353 500	1 504 500	1 389 000	1 385 400	4,11
3	Nigeria	206 100	698	3 555	2 845	2 860	-	2 490	0,01
4	Bangladesh	171 186	24 074	21 073	26 021	27 171	-	24 585	0,14
5	Russia	146 781	471 426	454 206	405 971	352 509	360 962	409 015	2,79
6	Japan	125 502	37 683	34 691	35 222	36 375	-	35 993	0,29
7	Phillippines	117 340	18 612	14 420	12 850	13 029	16 433	15 069	0,13
8	Egypt	112 717	50 662	51 963	51 533	49 341	45 435	49 787	0,44
9	Vietnam	100 300	3 790	2 764	2 245	3 440	3 562	3 160	0,03
10	Germany	83 020	217 145	217 145	197 834	229 497	-	215 405	2,59
11	France	67 244	316 100	282 800	254 151	286 600	277 100	283 350	4,21
12	Great Britain	65 185	222 511	189 266	186 571	191 164	216 763	201 255	3,09
13	Italy	60 317	252 384	242 205	264 664	270 068	-	257 330	4,27
14	Myanmar	54 580	2 155	2 139	2 107	1 507	1 362	1 854	0,03
15	Korea (South)	51 774	40 030	38 659	36 267	40 108	38 857	38 784	0,75
16	Spain	47 486	129 544	123800	127693	133029	-	128 517	2,71
17	Poland	37 766	153 500	128 800	106 466	135 965	99 205	124 787	3,30
18	Ukraine	37 441	96 812	101 279	79 457	80 652	68 549	85 350	2,28
19	Malaysia	34 309	50 720	38 865	36 886	28 475	34 389	37 867	1,10
20	Saudi Arabia	34 218	44 581	-	-	-	-	44 581	1,30
21	Ghana	33 475	6 168	6 319	6 547	6 796	5 973	6 361	0,19
22	Peru	32 000	14 263	14 249	-	13 167	11 647	13 332	0,42
23	Taiwan	23 561	22 866	22 248	21 684	15 890	17 466	20 031	0,85
24	Kazakhstan	20 333	13 850	13 933	12 256	12 219	11 805	12 813	0,63
25	Romania	19 053	-	33 883	30 597	-	31 204	31 895	1,67
26	Ecuador	18 000	-	-	-	3 221	-	3 221	0,18
27	Netherlands	17 591	38 900	-	44 313	-	-	41 607	2,37
28	Senegal	17 098	3 391	-	-	-	-	3 391	0,20
29	Cambodia	16 940	914	937	670	454	761	747	0,04
30	Belgium	11 697	-	35 208	32 619	32 972	30 885	32 921	2,81
31	Jordan	11 516	36 650	32 165	27 983	32 394	33 940	32 626	2,83
32	Tunis	11 403	1 659	-	-	-	-	1 659	0,15
33	Czech Republic	10 827	18 813	17 346	16 162	20 813	34 226	21 472	1,98
34	Greece	10 788	27 784	31 908	28 894	30 386	28 303	29 455	2,73
35	Sweden	10 552	26 445	25 502	-	-	22 881	24 943	2,36
36	Tadjikistan	10 160	-	-	-	-	1 236	1 236	0,12
37	Azerbaijan	10 154	-	2 118	2 092	2 095	1 907	2 053	0,20
38	Portugal	9 857	-	-	-	29 517	28 500	29 009	2,94
39	Hungary	9 765	20 913	20 716	22 428	18 516	-	20 643	2,11
40	Israel	9 656	50 958	46 458	81 073	78 257	-	64 187	6,65
41	UAE	9 517	-	1968	2090	3000	2473	2 383	0,25
42	Belarus	9 408	6 100	6 071	6 256	5 938	5 677	6 008	0,64
43	Austria	9 104	43 370	54 701	85 361	64 154	66 354	62 788	6,90
44	Switzerland	8 703	12 935	13 475	12 600	-	-	13 003	1,49
45	Paraguay	7 453	-	-	-	5 295	-	5 295	0,71
46	Papua New Guinea	7 200	-	-	219	123	-	171	0,02
47	Serbia	6 797	-	-	-	24 557	-	24 557	3,61
48	Kyrgyzstan	6 735	3 955	2 778	3 050	3 137	3 399	3 264	0,48
49	Bulgaria	6 520	42 141	33 693	30 918	35 992	33 974	35 344	5,42
50	Denmark	5 944	11 206	10 920	-	10 310	11 183	10 905	1,83
51	Singapore	5 637	2 862	1 877	1 844	1 799	-	2 096	0,37
52	Finland	5 565	-	12 043	12 245	11 909	-	12 066	2,17
53	New Zealand	5 123	20 714	22 575	20 005	14 304	17 230	18 966	3,70
54	Slovakia	5 042	9 602	8 704	7 710	-	-	8 672	1,72
55	Ireland	5 033	20 756	21 759	20 545	20 126	17 790	20 195	4,01
56	Oman	4 527	3 864	3 409	4 057	4 186	4 672	4 038	0,89
57	Panama	4 395	-	-	-	5 326	-	5 326	1,21
58	Croatia	3 860	14 980	14 452	14 087	15 479	10 414	13 882	3,60
59	Georgia	3 736	14800	13511	11150	13 273	10 564	12 660	3,39
60	Uruguay	3 499	-	-	22 691	24 020	24 701	23 804	6,80
61	Moldova	3 435	1 653	1 758	1 608	1 745	1 666	1 686	0,49
62	Mongolia	3 409	4 330	3 178	2 671	2 918	-	3 274	0,96
63	Qatar	2 881	11 509	8 846	-	-	-	10 178	3,53
64	Jamaica	2 827	10406	10209	8003	7 000	11 389	9 401	3,33
65	Lithuania	2 805	-	6 519	8 333	8 410	9 289	8 138	2,90
66	Armenia	2 728	2 260	2 196	-	-	-	2 228	0,82
67	Slovenia	2 108	-	7 778	7 819	-	-	7 799	3,70
68	Latvia	1 830	8 985	6 970	6 717	6 777	6 401	7 170	3,92
69	Estonia	1 365	4 675	3 989	3 873	3 203	3 240	3 796	2,78
70	Mauritius	1 260	7435	7858	5766	7113	4770	6 588	5,23
71	Cyprus	918	-	7 203	7 347	6 451	-	7 000	7,63
72	Bhutan	786	94	100	155	102	142	119	0,15
73	Luxemburg	602	2 186	-	2312	2 849	2 886	2 558	4,25
74	Brunei	445	2 045	1 124	756	717	783	1 085	2,44
75	Andorra	78	-	247	-	-	-	247	3,17
76	Liechtenstein	39	49	45	35	48	-	44	1,13
	∑	**3 745 812**	**4 226 038**	**4 181 076**	**3 819 824**	**3 993 248**	**3 061 348**	**3 856 307**	**1,03**

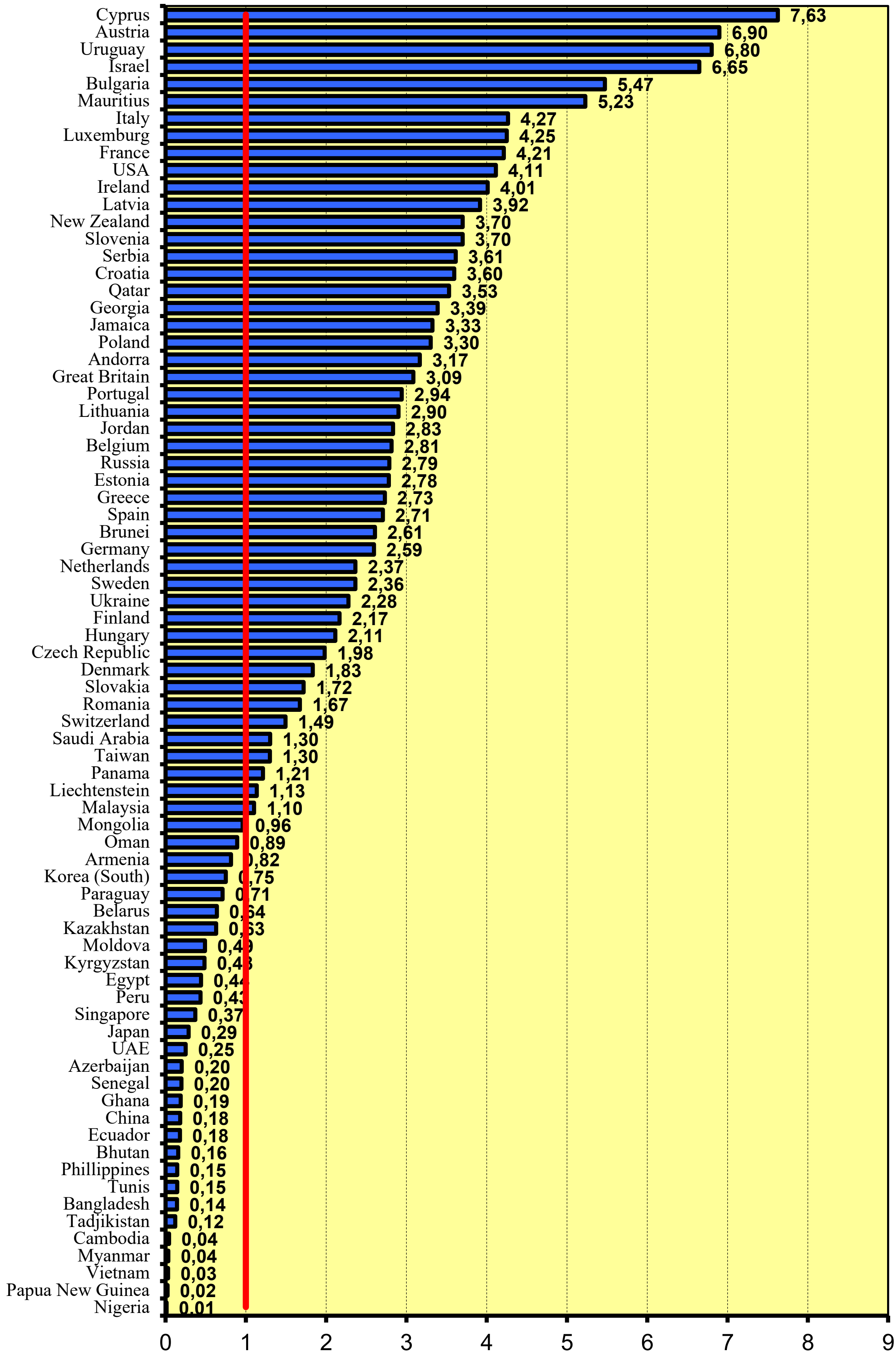


Fig. 1.7: Average number of fires per 1,000 inh. (2019-2023)
Fig. 1.7: Promedio de incendios por 1.000 hab. (2019-2023)
Bild 1.7: Mittlere Brandanzahl je 1.000 Einwohner (2019-2023)

Table/Cuadro/Tabelle 1.9

Trends in fire deaths in the countries of the World in 2019-2023
Dinámica de los fallecidos en incendios en países años 2019-2023
Dynamik der Brandtotenzahlen in den Staaten für die Jahre 2019-2023

№	Country / País / Staat	Population, thous. inh. / Habitantes, en miles / Einwohner in 1000	Number of fire deaths / Fallecidos por incendios / Anzahl der Brandtoten					Average number per / Promedio por / Mittelwert		
			2019	2020	2021	2022	2023	year / año / je Jahr	100000 inh. / 100000 hab. / je 100000 Einw.	100 fires / 100 incendios / je 100 Brände
1	China	1 390 000	1 469	1 183	-	-	-	1 326	0,10	0,52
2	India	1 359 000	10 915	9 110	8 348	7 435	-	8 952	0,66	-
3	USA	336 806	3 704	3 500	3 800	3 790	3070	3 573	1,06	0,26
4	Nigeria	206 100	-	147	-	-	-	147	0,07	5,90
5	Bangladesh	171 186	185	154	-	85	-	141	0,08	0,57
6	Russia	146 781	8 559	8 313	8 473	8 168	7825	8 268	5,63	2,02
7	Japan	125 502	1 486	1 326	1 417	1 446	-	1 419	1,13	3,94
8	Philippines	117 340	448	253	-	-	321	341	0,29	2,26
9	Egypt	112 717	252	199	252	203	239	229	0,20	0,46
10	Vietnam	100 352	85	75	85	146	157	110	0,11	3,47
11	Germany	83 020	387	388	364	373	-	378	0,46	0,18
12	France	67 244	261	249	277	373	-	290	0,43	0,10
13	Great Britain**	65 185	319	289	311	335	311	313	0,48	0,16
14	Myanmar	54 580	79	75	105	96	77	86	0,16	4,66
15	Korea (South)	51 774	284	364	276	341	283	310	0,60	0,80
16	Spain	47 486	165	164	204	235	-	192	0,40	0,15
17	Poland	37 766	508	488	516	508	482	500	1,33	0,40
18	Ukraine	37 441	1 909	1 728	1 853	1 651	1468	1 722	4,60	2,02
19	Saudi Arabia	34 218	183	-	-	-	-	183	0,53	0,48
20	Malaysia	33 940	121	118	-	121	-	120	0,35	0,27
21	Ghana	33 475	-	-	-	50	-	50	0,15	0,79
22	Taiwan	23 420	150	161	192	152	193	170	0,72	0,85
23	Kazakhstan	20 333	323	389	-	344	344	350	1,72	2,73
24	Romania	19 053		255	255	-	286	265	1,39	0,83
25	Ecuador	18 000	-	-	-	20	-	20	0,11	0,62
26	Netherlands	17 591	22	-	33	-	-	28	0,16	0,07
27	Cambodia	16 940	46	23	36	17	54	35	0,21	4,71
28	Belgium	11 697	-	66	58	54	27	51	0,44	0,16
29	Jordan	11 516	52	27	44	43	54	44	0,38	0,13
30	Czech Republic	10 827	128	144	110	128	105	123	1,14	0,57
31	Greece	10 788	21	69	63	72	-	56	0,52	0,19
32	Sweden	10 552	78	89	-	-	103	90	0,85	0,36
33	Azerbaijan	10 154	-	49	60	51	40	50	0,49	4,05
34	Portugal	9 857	-	-	-	51	37	44	0,45	2,14
35	Hungary	9 856	113	107	100	96	-	104	1,06	0,36
36	Israel	9 656	21	22	-	35	-	26	0,27	0,13
37	UAE	9 517	-	-	-	6	16	11	0,12	0,46
38	Belarus	9 508	489	633	672	629	524	589	6,20	9,81
39	Austria	9 104	-	41	51	49	60	50	0,55	0,08
40	Switzerland	8 703	18	17	17	-	-	17	0,20	0,13
41	Papua New Guinea	7 200	-	-	-	2	-	2	0,03	1,17
42	Serbia	6 787	-	-	-	102	-	102	1,50	0,42
43	Kyrgyzstan	6 735	50	43	54	29	29	41	0,61	1,26
44	Bulgaria	6 520	134	130	184	156	113	143	2,20	0,41
45	Denmark	5 944	49	54	-	58	50	53	0,89	0,48
46	Singapore	5 920	1	1	3	6	3	3	0,05	0,13
47	Finland	5 565	49	49	51	51	-	50	0,90	0,41
48	New Zealand	5 123	21	15	23	-	17	19	0,37	0,10
49	Norway	5 109	41	45	-	-	-	43	0,84	0,50
50	Slovakia	5 042	45	47	60	-	-	51	1,00	0,25
~~51~~	Ireland	5 033	16	29	20	19	17	20	0,40	0,50
52	Panama	4 395	-	-	-	6	-	6	0,14	0,11
53	Croatia	3 860	30	30	31	34	21	29	0,76	0,21
54	Georgia	3 689	46	65	45	59	-	54	1,46	0,42
55	Uruguay	3 499	150	42	44	184	157	115	3,30	0,48
56	Moldova	3 435	121	117	88	-	-	109	3,16	3,32
57	Mongolia	3 409	54	77	61	39	-	58	1,69	3,43
58	Qatar	2 881	3	17	-	-	-	10	0,35	0,10
59	Jamaica	2 827	35	31	42	24	27	32	1,12	0,34
60	Lithuania	2 805	70	95	94	72	100	86	3,07	1,06
61	Armenia	2 728	-	12	-	-	-	12	0,44	0,54
62	Slovenia	2 108	13	8	0	-	-	7	0,33	0,09
63	Latvia	1 857	76	83	102	74	68	81	4,34	1,12
64	Estonia	1 365	43	36	39	48	35	40	2,95	1,06
65	Mauritius	1 260	5	7	2	5	7	5	0,41	0,08
66	Cyprus	918	-	3	57	5	-	22	2,36	0,31
67	Bhutan	786	-	1	4	4	-	3	0,38	2,53
68	Luxemburg	602	-	-	0	-	-	0	0,00	0,00
69	Brunei	445	1	0	1	2	2	1	0,27	0,11
70	Iceland	357	1	6	-	-	-	4	0,98	1,42
71	Liechtenstein	39	1	1	0	0	-	1	1,28	1,13
	∑	**4 967 228**	**33 835**	**31 259**	**28 977**	**28 082**	**16 722**	**27 775**	**0,56**	**0,72**

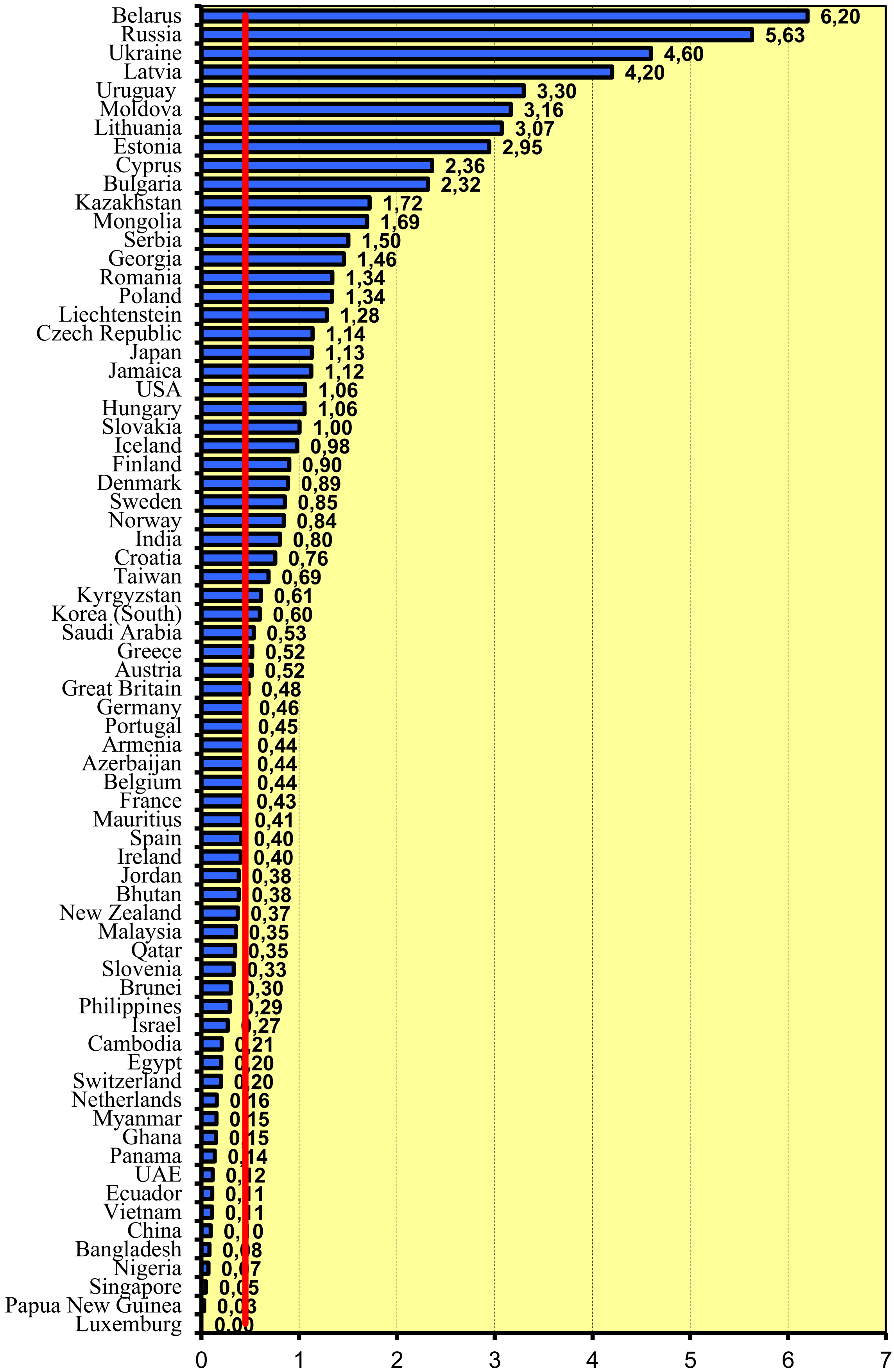


Fig. 1.8: Average number of fire deaths per 100,000 inh. (2019-2023)
Fig. 1.8: Promedio de fallecidos por 100.000 hab. (2019-2023)
Bild 1.8: Mittlere Brandtotenanzahl je 100.000 Einwohner (2019-2023)

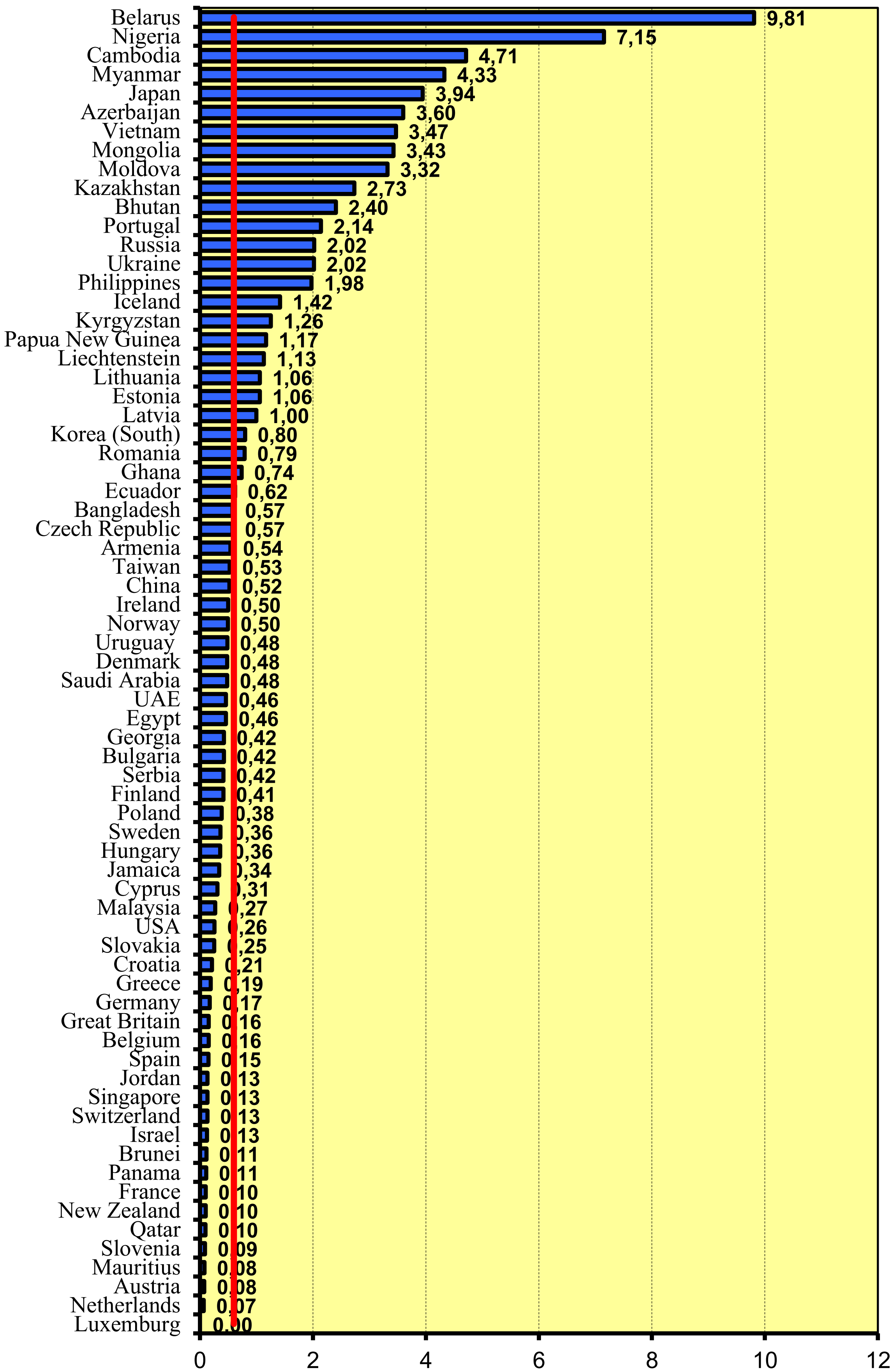


Fig. 1.9: Average number of fire deaths per 100 fires (2019-2023)
Fig. 1.9: Promedio de fallecidos por 100 incendios (2019-2023)
Bild 1.9: Mittlere Brandtotenanzahl je 100 Brände (2019-2023)

Table/Cuadro/Tabelle 1.10

Trends in fire injuries in the countries of the World in 2019-2023
Dinámica en lesionados por incendios en países del mundo años 2019-2023
Dynamik der Brandverletzten in den Staaten für die Jahre 2019-2023

№	Country	Population, thous. inh.	Number of fire injuries					Average number		
			2019	2020	2021	2022	2023	per year	per 100 thous.inh.	per 100 fires
	País	Habitantes, en miles	Lesionados por incendios					Promedio		
			2019	2020	2021	2022	2023	por año	por 100000 hab.	por 100 incendios
	Staat	Einwohner in 1000	Anzahl der Brandverletzten					Mittelwert		
			2019	2020	2021	2022	2023	je Jahr	je 100000 Einw.	je 100 Brände
1	USA	336 806	16 600	15 200	14 700	13 250	13 350	14 620	4,34	1,06
2	Bangladesh	171 186	586	317	-	495	-	466	0,27	1,90
3	Russia	146 781	8 461	8 434	8 403	8 165	-	8 366	5,70	2,05
4	Japan	126 146	5 865	5 583	5 433	5 719	-	5 650	4,48	15,70
5	Philippines	117 340	1 248	721	-	-	1 050	1 006	0,86	2,02
6	Egypt	110 990	1 203	878	824	855	-	940	0,85	6,24
7	Vietnam	100 300	126	144	130	109	136	129	0,13	4,08
8	France	67 244	1 289	24 798	13 905	1 398	-	10 348	15,39	3,65
9	Great Britain	64 903	8 750	-	7 772	7 599	-	8 040	12,39	4,00
10	Myanmar	53 900	226	220	151	-	-	199	0,37	10,73
11	Korea (South)	51 774	2 219	1 915	1 854	2 323	2 194	2 101	4,06	5,42
12	Poland	37 766	3 782	2 838	2 444	3 237	-	3 075	8,14	2,46
13	Ukraine	37 441	1 523	1 453	1 383	1 607	1 538	1 501	4,01	1,76
14	Malaysia	34 309	455	413	-	400	-	423	1,23	1,12
15	Saudi Arabia	34 218	2 059	-	-	-	-	2 059	6,02	4,62
16	Ghana	33 475	-	-	-	241	-	241	0,72	3,79
17	Taiwan	23 561	-	464	-	-	-	464	1,97	2,32
18	Kazakhstan	20 333	978	363	413	314	311	476	2,34	3,71
19	Romania	19 053	-	681	681	-	-	681	3,57	2,14
20	Ecuador	18 000	-	-	-	107	-	107	0,59	3,32
21	Cambodia	16 940	46	97	58	59	97	71	0,42	9,56
22	Belgium	11 697	-	1 247	1 573	1 426	395	1 160	9,92	3,52
23	Jordan	11 516	1 092	-	-	1 648	1 720	1 487	12,91	4,56
24	Czech Republic	10 827	1 388	1 250	1 221	1 552	1 410	1 364	12,60	6,35
25	Greece	10 788	36	44	44	95	-	55	0,51	0,19
26	Sweden	10 552	882	784	-	-	-	833	7,89	3,34
27	Portugal	9 857	-	-	-	1 303	1 325	1 314	13,33	4,53
28	Hungary	9 856	758	756	629	792	-	734	7,44	3,55
29	Israel	9 656	686	669	-	-	-	678	7,02	1,06
30	Belarus	9 408	444	408	388	502	535	455	4,84	7,58
31	Kyrgyzstan	6 735	-	28	44	24	-	32	0,48	0,98
32	Bulgaria	6 520	293	-	-	290	-	292	4,47	0,82
33	Singapore	5 637	142	184	194	171	-	173	3,06	8,24
34	Finland	5 565	-	595	531	365	-	497	8,93	4,12
35	New Zealand	5 123	273	301	308	187	264	267	5,20	1,41
36	Slovakia	5 042	343	240	191	-	-	258	5,12	2,98
37	Croatia	3 860	166	131	127	158	166	150	3,88	1,08
38	Georgia	3 689	274	203	184	193	-	214	5,79	1,69
39	Uruguay	3 499	366	93	381	501	422	353	10,08	1,48
40	Mongolia	3 409	68	45	-	33	-	49	1,43	1,49
41	Qatar	2 881	-	105	-	-	-	105	3,64	1,03
42	Jamaica	2 827	60	89	86	49	66	70	2,48	0,74
43	Lithuania	2 805	164	141	172	165	186	166	5,90	2,03
44	Armenia	2 728	-	42	-	-	-	42	1,54	1,89
45	Slovenia	2 108	209	155	33	-	-	132	6,28	1,70
46	Latvia	1 857	279	273	-	257	-	270	14,52	3,76
47	Estonia	1 365	113	120	103	83	70	98	7,16	2,58
48	Mauritius	1 260	7	9	20	7	29	14	1,14	0,22
49	Cyprus	880	-	103	19	31	-	51	5,80	0,73
50	Luxemburg	643	-	-	46	-	-	46	7,15	1,80
51	Brunei	445	5	17	1	4	-	7	1,52	0,62
52	Liechtenstein	39	-	-	1	3	-	2	5,13	4,52
	∑	**1 785 540**	**63 464**	**72 551**	**64 447**	**55 717**	**25 264**	**56 289**	**3,15**	**1,46**

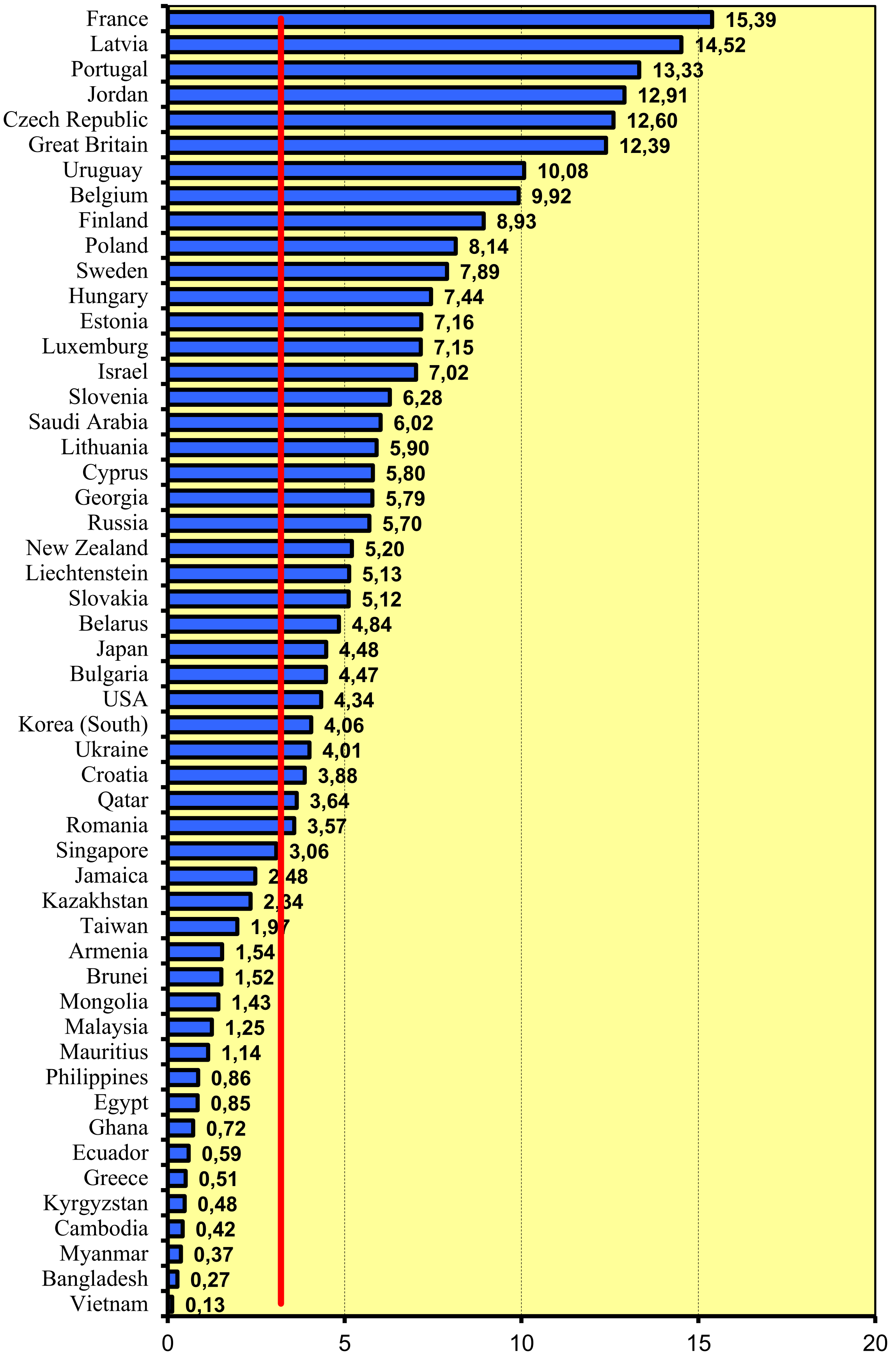


Fig. 1.10: Average number of fire injuries per 100,000 inh. (2019-2023)
Fig. 1.10: Promedio de lesionados por 100.000 hab. (2019-2023)
Bild 1.10: Brandverletzte je 100.000 Einwohner, Mittelwert (2019-2023)

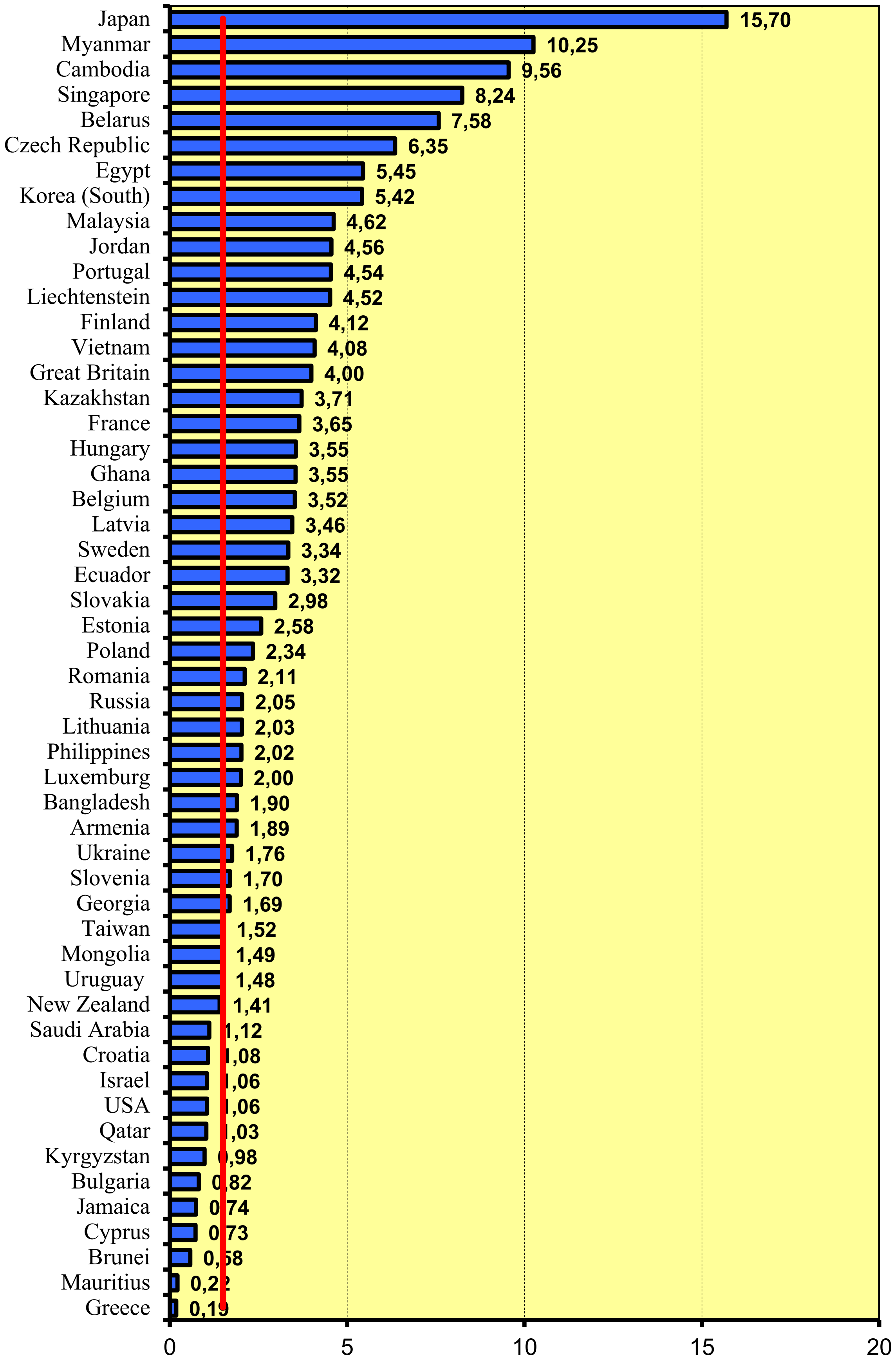


Fig. 1.11: Average number of fire injuries per 100 fires (2019-2023)
Fig. 1.11: Promedio de lesionados por 100 incendios (2019-2023)
Bild 1.11: Mittlere Anzahl an Verletzten je 100 Brände (2019-2023)

Table/Cuadro/Tabelle 1.11

Trends in firefighter deaths in the countries of the World in 2019-2023
Dinámica en Bomberos fallecidos en incendios en países para los años 2019-2023
Dynamik der Anzahl verunglückter Feuerwehrleute (FM) in den Staaten für 2019-2023

№	Country	Population, thous. inh.	Number of firefighter deaths					Average per year
			2019	2020	2021	2022	2023	
	País	Habitantes, en miles	Cantidad de Bomberos fallecidos					Promedio anual
			2019	2020	2021	2022	2023	
	Staat	Einwohner in 1000	Anzahl der getöteten FM					Mittelwert je Jahr
			2019	2020	2021	2022	2023	
1	USA	336 806	48	62	135	96	90	86,2
2	Bangladesh	171 186				13	-	13,0
3	Japan	125 502	12	7	2	-	-	7,0
4	France	66 309	-	-	7	11	-	9,0
5	Poland	37 766	1	2	0	5	-	2,0
6	Ukraine	37 441			1	6	1	2,7
7	Kazakhstan	20 333	0	10	-	2	-	4,0
8	Ecuador	18 000	-	-	-	0	-	0,0
9	Netherlands	17 591	0	-	0	-	-	0,0
10	Belgium	11 584	-	0	0	1	-	0,3
11	Jordan	11 516	-	-	-	-	0	0,0
12	Czech Republic	10 827	1	0	2	1	1	1,0
13	Greece	10 788	1	0	1	0	-	0,5
14	Sweden	10 552				0	0	0,0
15	Portugal	9 857	-	-	-	2	0	1,0
16	Hungary	9 856	0	0	0	0	-	0,0
17	Austria	9 104	-	-	1	0	-	0,5
18	Bulgaria	6 731	-	0	0	0	0	0,0
19	Denmark	5 825				0	-	0,0
20	Finland	5 565	-	0	1	1	-	0,7
21	Slovakia	5 042	0	0	0	-	-	0,0
22	Croatia	3 860	1	1	0	1	0	0,6
23	Lithuania	2 805	0	0	1	-	0	0,3
24	Latvia	1 857				0	-	0,0
25	Serbia	1 659				0	-	0,0
26	Estonia	1 365	0	-	0	1	0	0,3
27	Cyprus	918	-	-	0	-	-	0,0
28	Luxemburg	643	-	-	0	-	-	0,0
29	Liechtenstein	38	0	0	0	-	-	0,0
	∑	**951326**	**64**	**82**	**151**	**140**	**92**	**105,8**

Table/Cuadro/Tabelle 1.12

Trends in firefighter injuries in the countries of the World in 2019-2023
Dinámica de Bomberos lesionados en incendios en países años 2019-2023
Dynamik der Anzahl verunglückter Feuerwehrleute(FM) in den Staaten für 2019-2023

№	Country	Population, thous. inh.	Number of firefighter injuries					Average per year
			2019	2020	2021	2022	2023	
	País	Habitantes, en miles	Cantidad de Bomberos lesionados					Promedio anual
			2019	2020	2021	2022	2023	
	Staat	Einwohner in 1000	Anzahl der verletzten FM					Mittelwert je Jahr
			2019	2020	2021	2022	2023	
1	USA	336 806	60 225	64 875	60 750	65 650	63 075	62 915
2	Japan	125 502	2 229	1 424	1 460	-	-	1 704
3	France	66 309	-	-	10 882	7 773	-	9 328
4	Poland	37 766	388	244	313	504	-	362
5	Ukraine	37 441			22	54	24	33
6	Kazachstan	20 333	25	2	-	9	-	12
7	Equador	18 000	-	-	-	0	-	0
8	Belgium	11 584	-	94	62	81	-	79
9	Jordan	11 516	-	-	-	-	92	92
10	Czech Republic	10 827	217	271	183	280	230	236
11	Greece	10 788	13	20	41	34	-	27
12	Sweden	10 552				-	78	78
13	Portugal	9 857	-	-	-	439	403	421
14	Hungary	9 856	67	60	63	55	-	61
15	Bulgaria	6 731	-	13	11	44	44	28
16	Finland	5 565	-	63	70	66	-	66
17	Slovakia	5 042	45	45	9	-	-	33
18	Croatia	3 860	17	22	27	30	42	28
19	Lithuania	2 805	29	23	16	17	31	23
20	Slovenia	2 108	146	-	48	-	-	97
21	Latvia	1 857				0	-	0
22	Serbia	1 659				28	-	28
23	Estonia	1 365	52	-	47	46	40	46
24	Cyprus	918	-	1	0	-	-	1
25	Luxemburg	643	-	-	45	-	-	45
26	Liechtenstein	37	0	0	0	-	-	0
	∑	**749 727**	**63 453**	**67 157**	**74 049**	**75 110**	**64 059**	**68 766**

Table/Cuadro/Tabelle 1.13

Statistics of fire services in the countries of the World in 2010-2023 (most recent data)

Estadísticas de personal y equipos en países en 2010-2023

Personal und Ausstattung der Feuerwehren der Staaten in 2010-2023

№	Country	Population thous.inh.	Fire stations	Number of		Number of firefighters			
				engines	ladders	career	part time	volunt.	total
	País	Habitantes, en miles	Estaciones de Bomber.	Cantidad de		Number of firefighters			
				Bombas	Escalas	Rentados	Medio tiempo	volunt.	total
	Staat	Einwohner in 1000	Feuer-wachen	Anzahl der Fahrzeuge		Personal der Feuerwehr			
				LF, TLF	DL, TM	BF	Teilzeit	FF	Gesamt
1	China	1 386 000	-	-	-	130 000	-	7 500 000	7 630 000
2	USA	336 806	58 700	71 700	7 500	383 000	-	635 100	1 018 100
3	Bangladesh	171 186	492	1 568	28	12 702	1 053	-	13 755
4	Russia	146 781	18 322	22 735	1 326	271 000	-	956 600	1 227 600
5	Japan	125 823	3 093	7 767	1 077	166 287	0	762 770	929 057
6	Philippines	108 771	1 396	2 803	48	26 751	-	-	26 751
7	Vietnam	100 300	486	1 876	234	9 678	-	950 735	960 413
8	Germany	83 020	37 175	41 064	2 509	34 854	-	1 003 594	1 038 448
9	France	66 309	6 503	7 478	1 231	54 503	-	198 790	253 293
10	Great Britain	64 903	2 053	2 900	235	40 100	19 000	1 400	60 500
11	Iran	64 000	452	1 300	20	9 285	-	-	9 285
12	Italy	61 000	902	2 330	307	28 870	-	20 060	48 930
13	Korea (South)	51 774	226	2 204	453	60 994	-	96 561	157 555
14	Poland	37 766	496	1 625	539	30 349	-	505 520	535 869
15	Ukraine	37 441	2 270	3 134	367	53 286	-	190 031	243 317
16	Canada	35 544	-	-	-	26 000	-	126 650	152 650
17	Malaysia	33 938	325	589	49	13 455	2 111	12 414	27 980
18	Peru	26 000	174	-	-	-	-	-	-
19	Taiwan	22 450	544	959	197	8 180	-	26 500	34 680
20	Kazakhstan	20 333	435	1 650	375	17 500	-	43 000	60 500
21	Australia	20 016	-	4 448	-	-	-	-	-
22	Romania	19 053	391	833	138	25 632	-	61 833	87 465
23	Ecuador	18 000	52	92	4	523	-	1 732	2 255
24	Netherlands	17 591	953	1 070	130	3 145	1 089	18 258	22 492
25	Belgium	11 697	320	1 680	270	6 710	0	10 388	17 098
26	Jordan	11 516	445	207	21	4 660	-	379	5 039
27	Czech Republic	10 827	6 492	4 882	457	13 998	5 382	75 236	94 616
28	Greece	10 788	286	2 104	109	13 530	-	3 779	17 309
29	Sweden	10 552	935	-	-	5 055	10 894	-	15 949
30	Portugal	9 857	434	1 556	186	12 263	0	17 975	30 238
31	Hungary	9 856	291	1 057	115	10 045	-	21 442	31 487
32	Israel	9 656	122	290	42	2 064	-	-	2 064
33	Belarus	9 408	714	1 922	178	9 276	-	6 660	15 936
34	Austria	9 104	5 550	8 636	321	2 775	-	300 891	303 666
35	Switzerland	8 500	1 272	-	-	1 185	0	80 110	81 295
36	Serbia	6 797	159	1 183	41	3 415	-	3 000	6 415
37	Bulgaria	6 731	243	694	52	6 545	0	3 448	9 993
38	Laos	6 522	17	52	1	244	0	0	244
39	Denmark	5 825	286	423	91	1 426	5 189	-	6 615
40	Singapore	5 637	23	103	23	2 759	-	-	2 759
41	Finland	5 565	890	1 148	78	3 791	3 400	11 700	18 891
42	Georgia	5 266	119	200	15	5 128	-	-	5 128
43	New Zealand	5 123	648	661	25	1 750	-	11 925	13 675
44	Norway	5 109	597	963	70	3 718	8 152	-	11 870
45	Slovakia	5 042	118	351	108	4 296	-	79 004	83 300
46	Ireland	5 033	215	300	46	2 012	2 076	0	4 088
47	Costa Rica	4 973	76	-	-	-	-	-	-
48	Panama	4 395	85	15	1	1 708	-	3 896	5 604
49	Croatia	3 860	2 091	2 413	147	4 135	1 100	58 665	63 900
50	Kuwait	3 800	39	50	11	3 800	-	-	3 800
51	Albania	3 601	45	68	6	724	-	-	724
52	Moldova	3 553	62	163	25	1381	-	90	1 471
53	Mongolia	3 297	64	138	6	3 152	74	-	3 226
54	Lithuania	2 805	87	285	51	2 112	-	1 527	3 639
55	Armenia	2 728	61	147	12	2 172	-	225	2 397
56	Slovenia	2 108	1 337	1 462	53	1 000	0	35 689	36 689
57	Latvia	1 857	91	241	37	2 690	-	547	3 237
58	Bahrain	1 557	13	24	6	604	-	-	604
59	Estonia	1 365	72	78	11	1 549	10	2 629	4 188
60	Cyprus	918	35	176	6	764	213	182	1 159
61	Luxemburg	643	99	171	26	552	-	3 346	3 898
62	Brunei	430	23	40	3	1 320	-	-	1 320
63	Barbados	267	6	13	2	214	-	-	214
64	Andorra	78	4	17	-	120	-	-	120
65	Liechtenstein	39	15	13	4	0	0	622	622
	∑	**3 271 490**	**159 921**	**214 051**	**19 423**	**1 550 736**	**59 743**	**13 844 903**	**15 455 382**

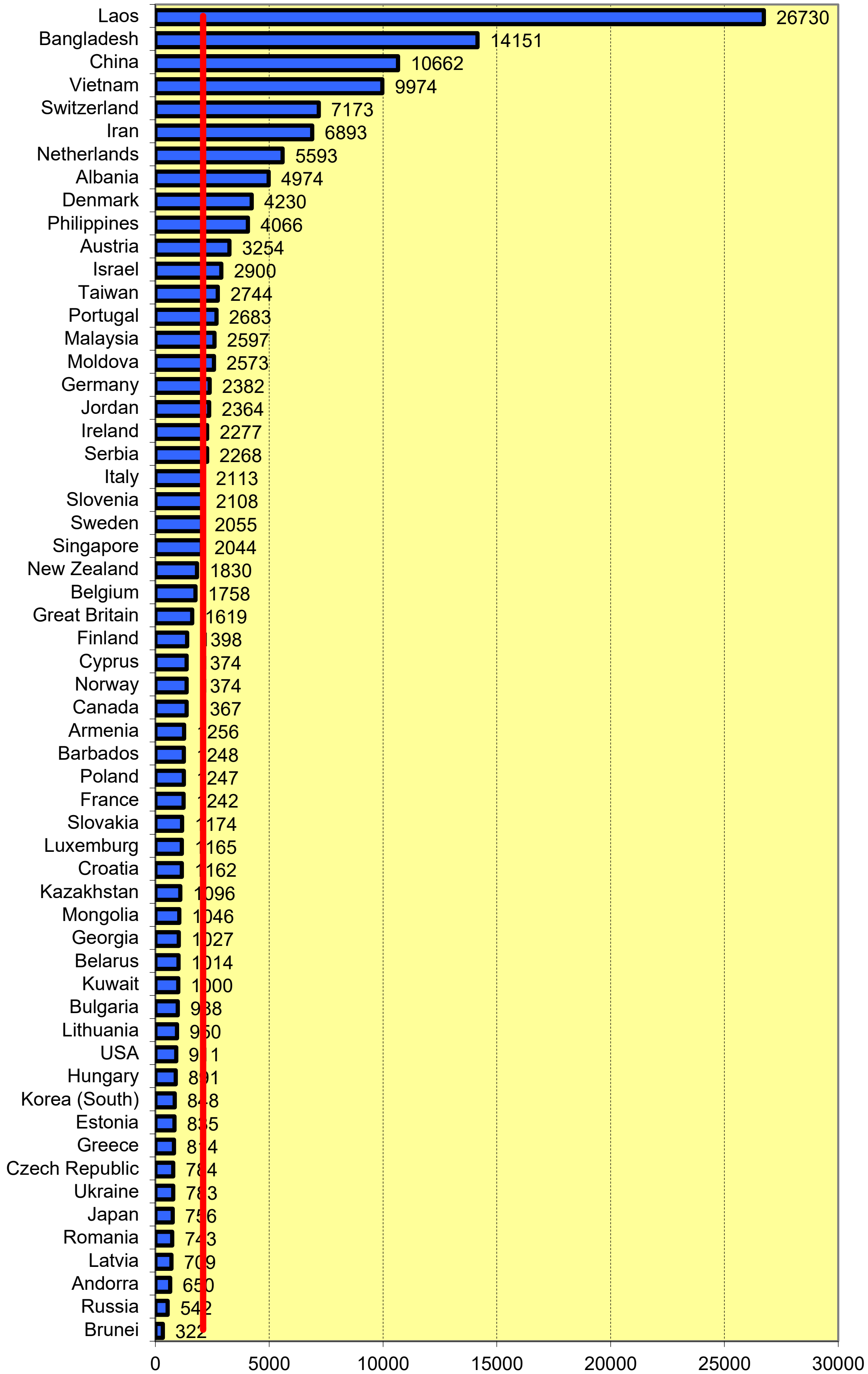


Fig. 1.12: Average number of inhabitants per 1 career firefighter (2010-2023)
Fig. 1.12: Promedio de hab. por 1 Bombrero rentado (2010-2023)
Bild 1.12: Mittlere Einwohneranzahl auf 1 Berufsfeuerwehrmann (2010-2023)

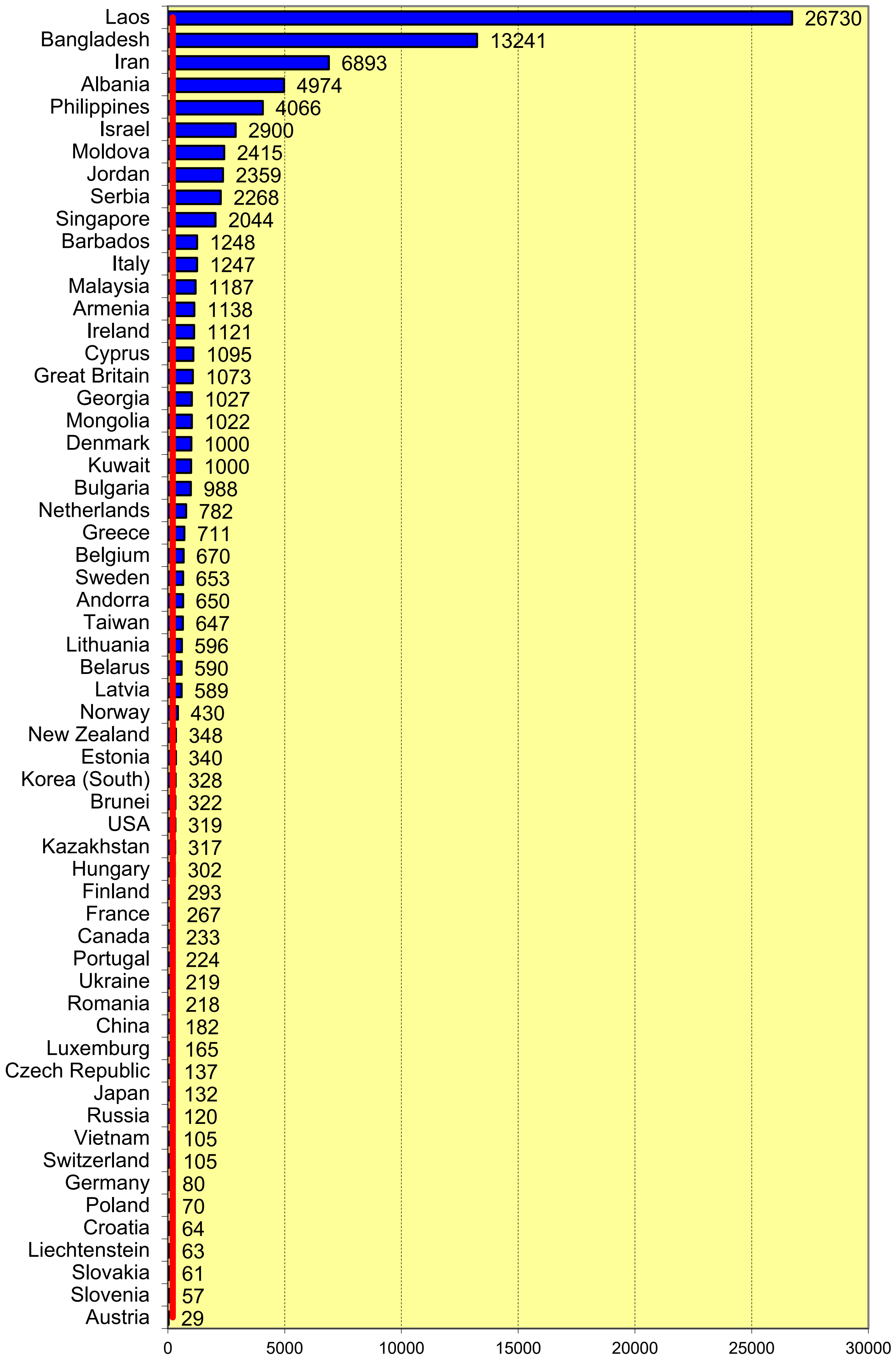


Fig. 1.13: Average number of inhabitants per 1 firefighter (2010-2023)
Fig. 1.13: Promedoi de habotantes por cada bombero (2010-2023)
Bild 1.13: Mittlere Einwohnerzahl auf 1 Feuerwehrmann (2010-2023)

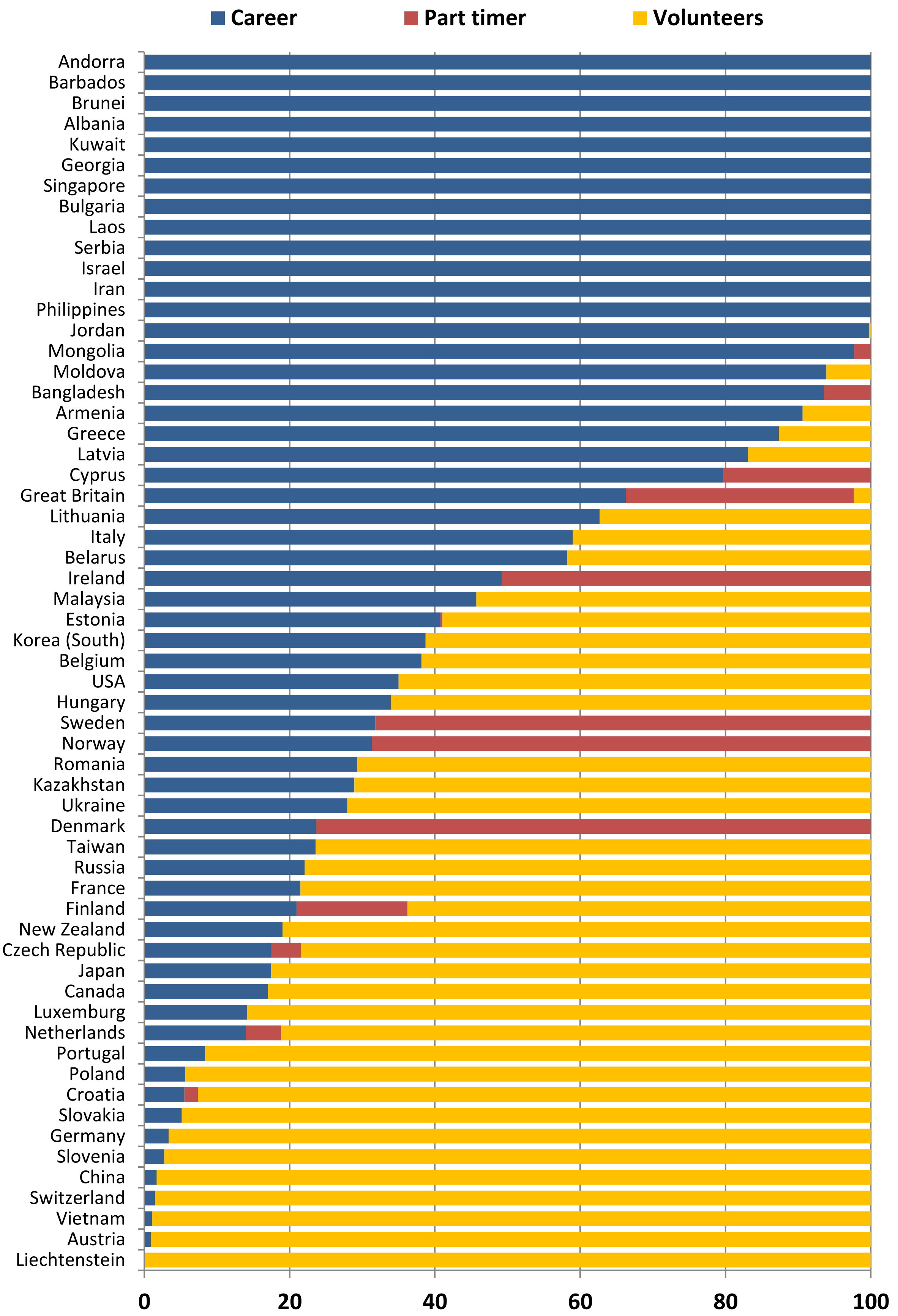


Fig. 1.14: Contributions of categories of firefighters to total firefighters number [%]
Fig. 1.14: Cantidad de Bomberos según su categoria [%]
Bild 1.14: Anteile der Feuerwehrmannkategorien [%]

Table/Cuadro/Tabelle 1.14

Fire service personnel by gender in the countries of the World in 2010-2023 (most recent data)
Personal de Bomberos según género en países del mundo años 2010-2023 (Datos mas recientes)
Personal der Feuerwehren der Staaten nach Gender in 2010-2023

№	Country / País / Staat	Population thous.inh. / Población en miles / Einwohner in 1000	Male / Masculino / Männer	%	Female / Femenino / Frauen	%	Total / Total / Gesamt
			Number of firefighters / Cantidad de Bomberos / Personal der Feuerwehr				
1	USA	336 806	921 300	90	96 800	10	1 018 100
2	Bangladesh	171 186	13 641	99	114	1	13 755
3	Russia*	146 781	233 227	86	37 773	14	271 000
4	Japan	125 823	914 251	97	33 020	3	947 271
5	Philippines	108 771	19 809	74	6 942		26 751
6	Germany	82 218	938 525	91	89 471	9	1 027 996
7	France	66 309	202 726	80	50 567	20	253 293
8	Italy	61 000	47 503	97	1 427	3	48 930
9	Korea (South)	51 738	146 035	79	39 006	21	185 041
10	Poland	37 766	476 907	89	58 855	11	535 762
11	Malasyia	33 938	14 933	96	679	4	15 612
12	Taiwan	23 561	14 301	88	1 919	12	16 220
13	Romania	19 053	85 858	98	1 607	2	87 465
14	Ecuador	18 000	1 821	81	434	19	2 255
15	Netherlands	17 591	21 113	94	1 379	6	22 492
16	Belgium	11 584	16 733	98	413	2	17 146
17	Jordan	11 516	4 527	90	512	10	5 039
18	Czech Republic	10 827	80 112	99	1 064	1	81 176
19	Greece	10 788	15 638	90	1 671	10	17 309
20	Sweden	10 552	14 658	92	1 291	8	15 949
21	Portugal	9 857	22 956	76	7 189	24	30 145
22	Hungary*	9 856	30 737	98	750	2	31 487
23	Israel	9 656	2 045	99	19	1	2 064
24	Austria	9 104	283 088	93	20 578	7	303 666
25	Switzerland*	8 500	81 295	91	8 395	9	89 690
26	Serbia	6 797	3 104	98	65	2	3 169
27	Bulgaria	6 731	9 537	95	456	5	9 993
28	Denmark	5 825	6 305	95	310	5	6 615
29	Singapore	5 637	2 268	82	491	18	2 759
30	Finland	5 565	16 873	90	1 894	10	18 767
31	New Zealand	5 151	10 962	80	2 713	20	13 675
32	Norway	5 109	11 673	98	197	2	11 870
33	Slovakia*	5 042	67 455	81	15 845	19	83 300
34	Ireland	4 459	3 547	100	0	0	3 547
35	Croatia	3 860	53 898	84	10 002	16	63 900
36	Mongolia	3 297	3 224	100	2	0	3 226
37	Armenia	2 972	2 164	97	67	3	2 231
38	Lithuania	2 805	4 556	100	16	0	4 572
39	Slovenia	2 108	31 932	87	4 757	13	36 689
40	Latvia	1 857	5 587	100	0	0	5 587
41	Estonia	1 365	3 633	87	555	13	4 188
42	Cyprus	918	1 063	92	96	8	1 159
43	Luxemburg	643	2 330	60	1 568	40	3 898
44	Brunei	430	1 139	86	181	14	1 320
45	Liechtenstein	39	588	95	34	5	622
∑		**1 473 391**	**4 845 577**	**91**	**501 124**	**9**	**5 346 701**

* - career / professionals / BF

Table/Cuadro/Tabelle 1.15

Number of young firefighters in the countries of the World in 2010-2023 (most recent data)
Cantidad de Cadetes o Brigadiers en los países en 2010-2023 (datos mas recientes)
Anzahl der Jugendlichen in den Feuerwehren der Staaten in 2010-2023

№	Country / País / Staat	Population thous.inh. / Habitantes en miles / Einwohner in 1000	Number of young firefighters / Cantidad de jóvenes / Jugendfeuerwehrmitglieder
1	USA	336 806	28 800
2	Russia	146 781	262 354
3	Japan	125 502	388 512
4	Germany	82 218	274 694
5	France	66 309	28 763
6	Republic of Korea	51 738	4 357
7	Poland	38 265	83 817
8	Romania	19 053	19 940
9	Jordan	11 516	790
10	Greece	10 788	523
11	Hungary	9 856	2 198
12	Belarus	9 408	159 041
13	Austria	9 104	33 775
14	Finland	5 565	9 400
15	Slovakia	5 042	6 296
16	Croatia	3 860	30 941
17	Slovenia	2 108	40 431
18	Latvia	1 857	300
19	Cyprus	918	66
20	Luxemburg	643	1 142
21	Liechtenstein	39	70
∑		**600 570**	**1 347 410**

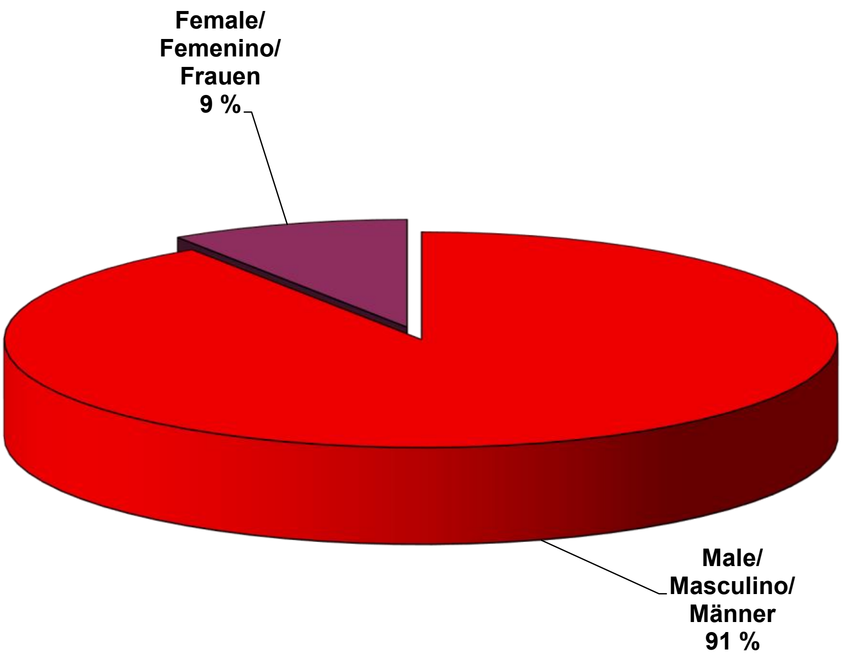


Fig. 1.15: Fire service personnel by gender in the countries of the World in 2010-2023 (most recent data)
Fig. 1.15: Personal de Bomberos según género en países del mundo años 2010-2023 (Datos mas recientes)
Bild 1.15: Personal der Feuerwehren der Staaten

Table/Cuadro/Tabelle 1.16

Distribution of fires by fire causes in 2021-2023
Distribución de incendios por causas en 2021-2023
Verteilung der Brandursachen 2021-2023

№	Country	Population, thous.inh.	Electricity Equipment Failure	Gas Equipment Failure	Playing with fire	Careless ness	Smoking	Fireplace, stove	Arson	Other known causes	Unknown causes	Total
№	**Country**	**Población, miles de habitantes**	**Falla de Equipos Eléctricos**	**Falla de Equipos de Gas**	**Jugar con fuego**	**Descuido**	**Fumado**	**Chimenea, estufa**	**Incendio provocado**	**Otras causas conocidas**	**Causas desconocidas**	**Total**
№	**Staat**	**Einwohner in 1.000**	**Elektri- sche Geräte**	**Gas- geräte**	**Spielen mit Feuer**	**Unvor- sichtig- keit**	**Rauchen**	**Feuer- stätten**	**Brand- stiftung**	**Andere bekannte Ursachen**	**Unbekannt**	**Total**
1	USA	336 806	34 090	-	3 030	-	15 200	34 850	24 600	-	-	**111 770**
2	Russia	146 781	58 278	1 510	2 274	230 043	-	25 389	12 682	19 207	3 126	**352 509**
3	Egypt	110 990	9 407	1 770	-	-	-	106	-	16 203	21 855	**49 341**
4	Poland	37 766	6 099	431	820	4 506	29 792	16 789	43 235	9 073	25 210	**135 955**
5	Ukrane	37 441	9 828	299	396	22 229	16 060	3 922	2 115	13 015	70	**67 934**
6	Kazakhstan	20 333	5 012	86	2 329	-	-	1 604	624	2 150	-	**11 805**
7	Czech Republic	10 827	2 224	4	106	8 291	1 142	1 367	854	2 604	1 166	**17 758**
8	Greece	10 788	134	43	-	508	1 347	-	75	3 911	14 494	**20 512**
9	Azerbaijan	10 154	878	-	16	111	43	59	292	493	-	**1 892**
10	Hungary	9 856	56	32	198	54	26	32	197	6	95	**696**
11	Austria	9 104	1 362	-	-	-	-	1 403	315	3 867	1 936	**8 883**
12	Serbia	6 759	184	-	-	-	88	290	-	198	22 392	**23 152**
13	Bulgaria	6 731	326	219	104	13 733	177	1 238	253	16 975	1 129	**34 154**
14	Kyrgyzstan	6 631	408	-	282	305	-	286	-	-	886	**2 167**
15	Denmark	5 825	624	-	92	3 252	627	288	2 077	721	2 629	**10 310**
16	Finland	5 565	709	-	167	1 005	357	1 743	908	563	1 216	**6 668**
17	New Zaeland	5 123	2 151	-	76	996	454	1 034	996	10 032	1 478	**17 217**
18	Ireland	5 033	198	-	-	169	192	1 338	1 127	427	5 627	**9 078**
19	Panama	4 395	1 234	804	-	12	162	12	-	-	-	**2 224**
20	Lithuania	2 805	1 301	36	58	1 586	222	1 170	266	3 259	7	**7 905**
21	Latvia	1 883	1 337	-	34	2 491	1 203	869	161	268	-	**6 363**
22	Estonia	1 365	396	-	65	-	119	249	118	1 327	965	**3 239**
23	Cyprus	918	179	28	357	-	214	80	492	3 282	-	**4 632**
	∑	**793 879**	**136 415**	**5 262**	**10 404**	**227 769**	**67 425**	**94 118**	**91 387**	**107 581**	**104 281**	**906 164**

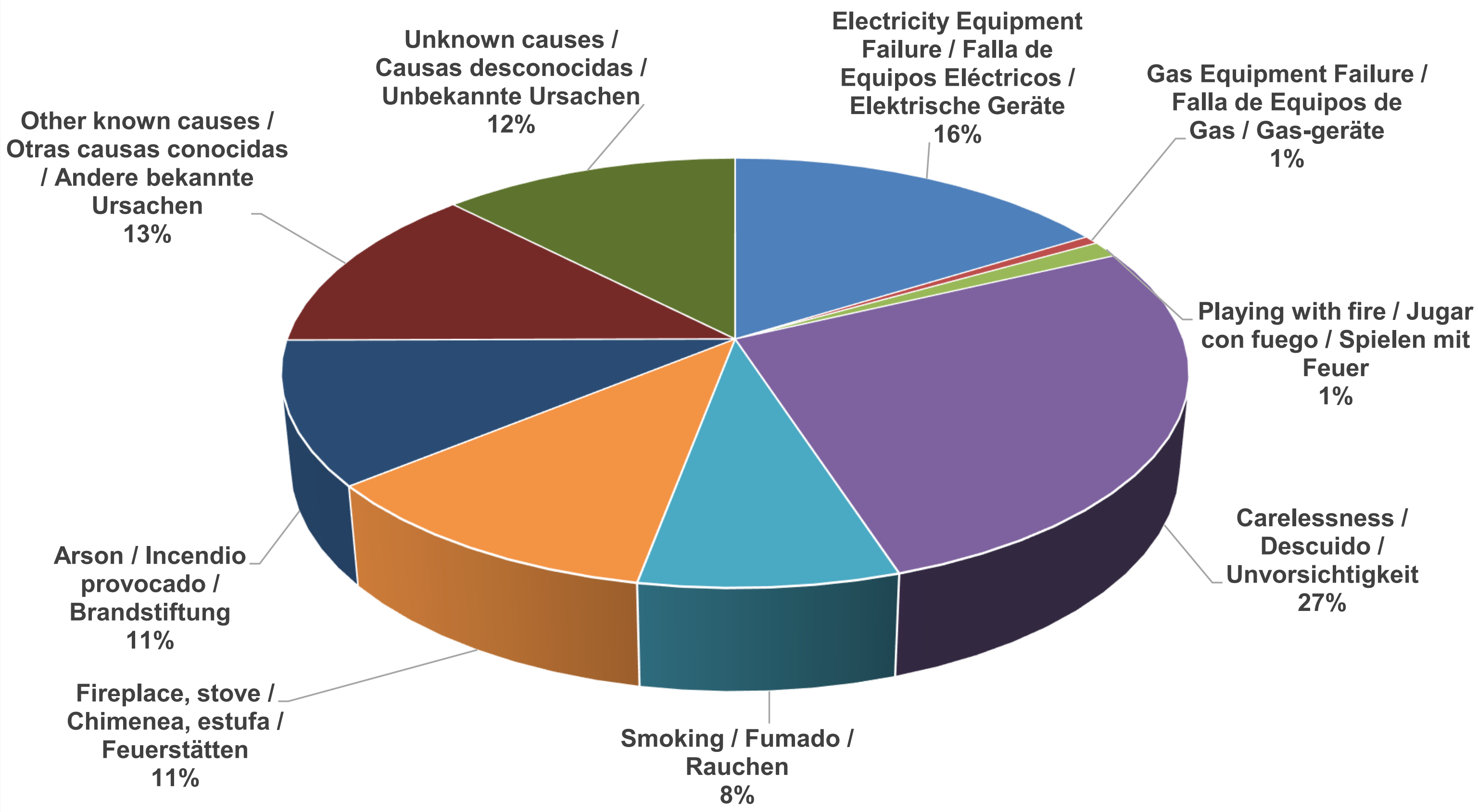


Fig. 1.16: Distribution of fires by fire cause in 2021-2023
Fig. 1.16: Distribución de incendios por causas en 2021-2023
Bild 1.16: Verteilung der Brandursachen (2021-2023)

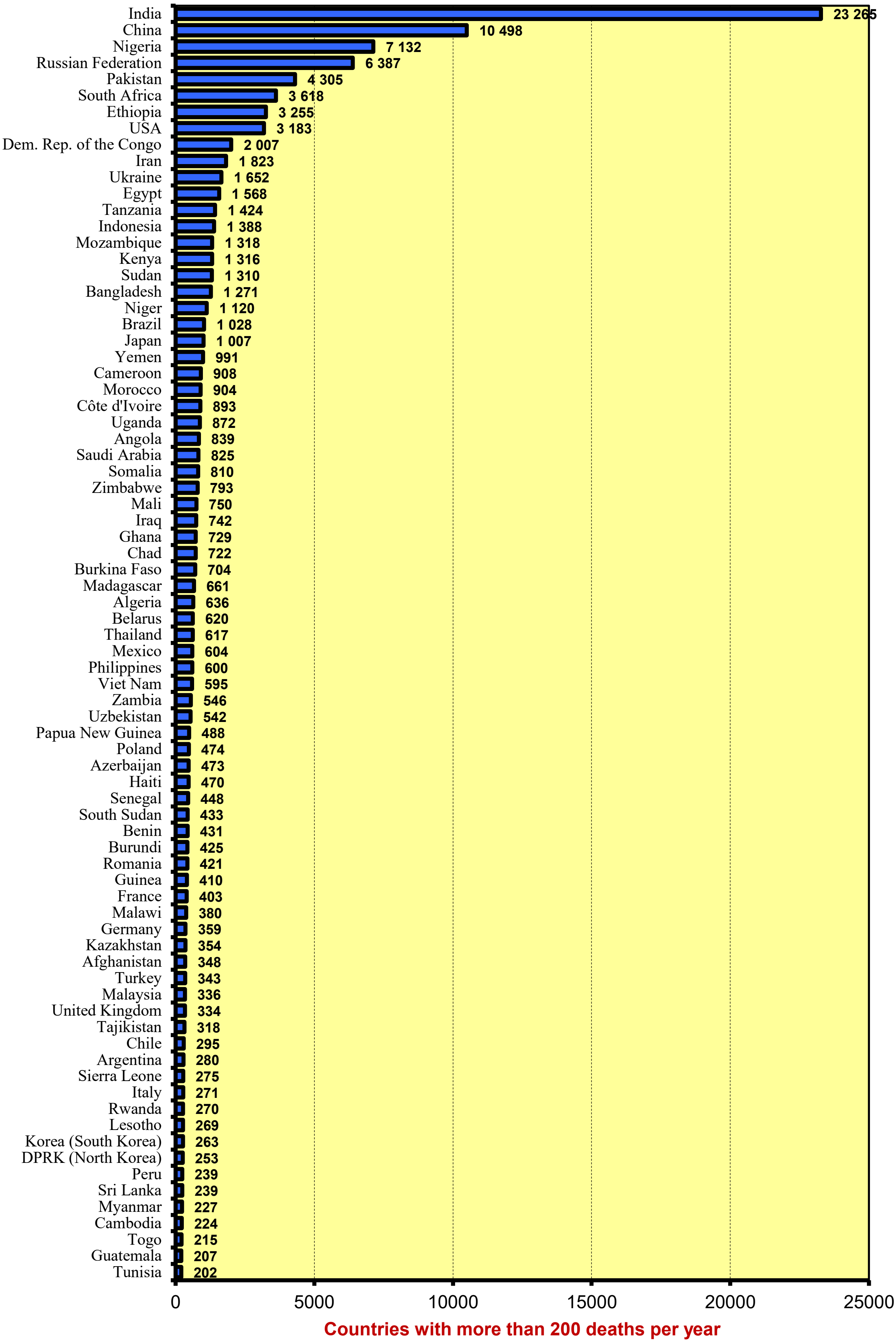


Fig. 1.17: Distribution of estimated deaths from fire, heat and hot substances (WHO 2019)
Fig. 1.17: Distribución estimada de fallecidos por "fuego, calor y sust. calientes"
Bild 1.17: Verteilung der Toten "Feuer, Flamme, heiße Substanzen" (WHO 2019)

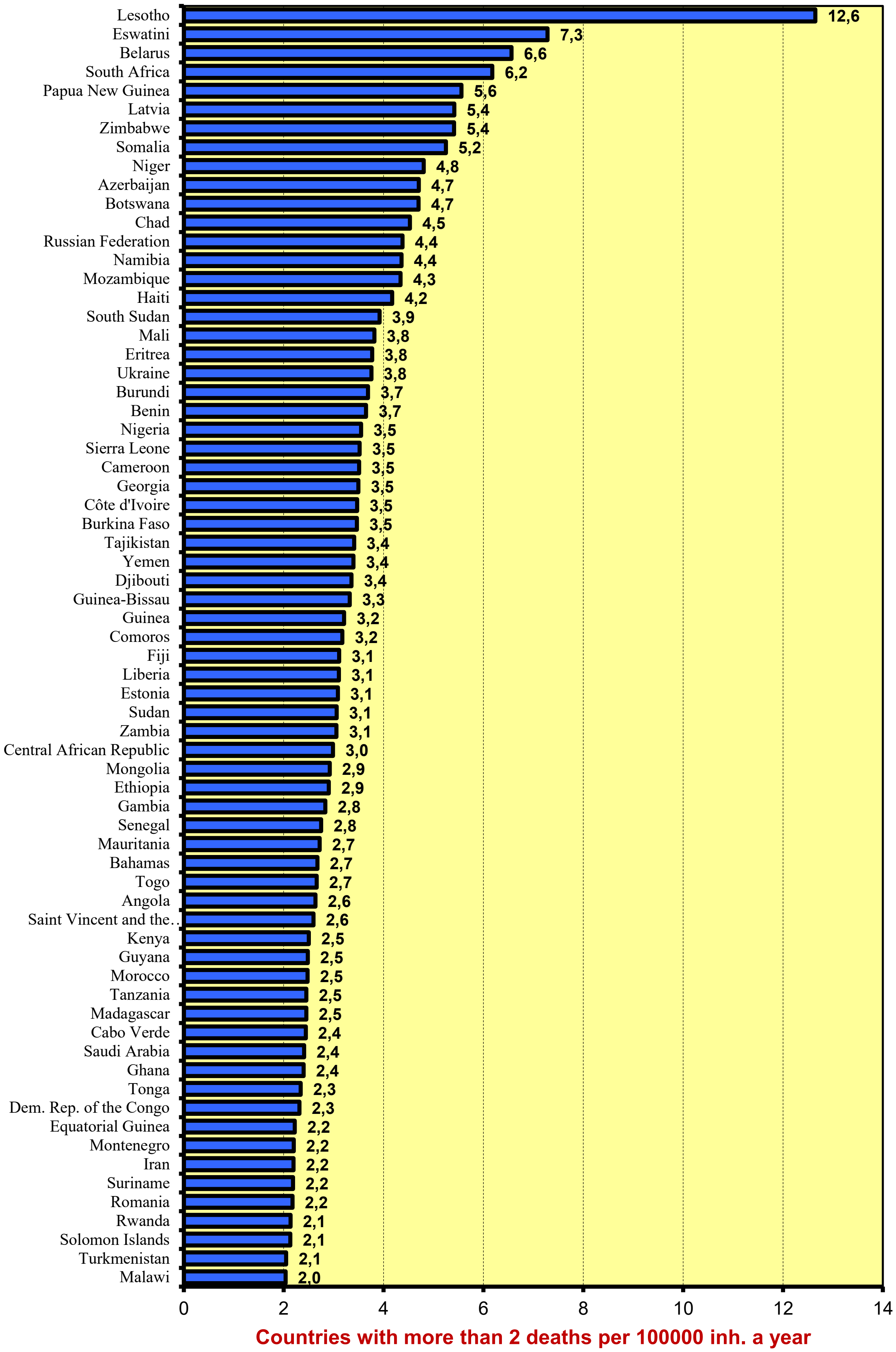


Fig. 1.18: Distribution of estimated deaths from fire, heat and hot substances (WHO 2019)
Fig.1.18: Distribución estimada de fallecidos por "fuego, calor y sust. calientes"
Bild 1.18: Verteilung der Toten "Feuer, Flamme, heiße Substanzen" (WHO 2019)

Table/Cuadro/Tabelle 2.1

Common indicators of fire statistics in the cities of the World in 2023
Indicadores comunes en las estadísticas de incendios en ciudades del mundo en 2023
Verdichtete Kennzahlen zum Arbeitsumfang und zur Brandsituation in den Städten der Welt im Jahr 2023

№	City	Population thous. inhabitants	Area sq.km.	Number of				Average number					
				calls	fires	fire deaths	fire injuries	per 1000 inh.:		of fire deaths per:		of fire injuries per:	
								calls	fires	100000 inh.	100 fires	100000 inh.	100 fires
	Ciudad	Habitantes por mil	Area en km cuadrados	Cantidad de				Promedio					
				Operaciones	Incendios	Fallecidos incend.	Lesionados incend.	Por 1000 habs.		Fallecidos por		Lesionados por	
								Operaci.	Incendios	100000 hab.	100 incendios	100000 hab.	100 incendios
	Stadt	Einwohner in 1 000	Fläche, in qkm	Anzahl der …				Mittelwert					
				Einsätze	Brände	Brandtoten	Verletzten	je 1000 Einw.:		Brandtotenanzahl je:		Verletztenanzahl je:	
								Einsätze	Brände	100000 Einw.	100 Brände	100000 Einw.	100 Brände
1	Istanbul	15 910	5 220	122 544	24 285	-	-	7,7	1,5	-	-	-	-
2	Moscow	12 600	2 561	69 300	6 378	151	409	5,5	0,5	1,2	2,4	3,2	6,4
3	London	9 726	1 707	126 464	16 120	-	-	-	1,7	-	-	-	-
4	Seoul	9 384	605	-	5 671	24	283	-	0,6	0,3	0,4	3,0	5,0
5	Hong Kong	7 413	1 114	810 218	36 103	31	361	109,3	4,9	0,4	0,1	4,9	1,0
6	Paris	7 019	800	495 397	15 546	-	-	70,6	2,2	-	-	-	-
7	St. Petersburg	5 380	1 404	43 488	8 424	132	216	8,1	1,6	2,5	1,6	-	-
8	Athens	3 074	412	18 784	5 614	14	10	6,1	1,8	0,5	0,2	0,3	0,2
9	Kyiv	2 887	851	10 640	3 584	64	140	3,7	1,2	2,2	1,8	4,8	3,9
10	Toronto	2 800	630	184 841	38 267	14	-	66,0	13,7	0,5	0,0	-	-
11	Phnom Penh	2 082	679	-	152	8	3	-	0,1	0,4	5,3	0,1	2,0
12	Vienna	2 005	415	47 272	13 925	-	-	23,6	6,9	-	-	-	-
13	Astana	1 544	722	3 000	632	12	28	1,9	0,4	0,8	1,9	1,8	4,4
14	Prague	1 357	496	468 828	4 351	9	102	345,5	3,2	0,7	0,2	7,5	2,3
15	Sofia	1 290	492	12 186	3 532	13	23	9,4	2,7	1,0	0,4	1,8	0,7
16	Brussels	1 241	162	-	1 095	2	48	-	0,9	0,2	0,2	3,9	4,4
17	Dublin	1 186	921	95 942	8 454	1	-	80,9	7,1	0,1	0,0	-	-
18	Stockholm	989	187	6 190	1 192	6	90	6,3	1,2	0,6	0,5	9,1	7,6
19	Zagreb	771	641	5 711	1 315	2	31	7,4	1,7	0,3	0,2	4,0	2,4
20	Copenhagen	655	89	5 922	1 104	5	-	9,0	1,7	0,8	0,5	-	-
21	Riga	609	304	6 886	2 082	15	104	11,3	3,4	2,5	0,7	17,1	5,0
22	Vilnius	563	401	4 030	1 083	13	24	7,2	1,9	2,3	1,2	4,3	2,2
23	Lisbon	545	100	13 114	2 211	2	284	24,1	4,1	0,4	0,1	52,1	12,8
24	Tallinn	453	159	6 527	717	9	24	14,4	1,6	2,0	1,3	5,3	3,3
25	Wellington	216	290	4 416	473	1	5	20,4	2,2	0,5	0,2	2,3	1,1
	∑	**91 699**	**21 362**	**2 561 700**	**202 310**	**528**	**2 185**	**27,9**	**2,2**	**0,6**	**0,3**	**2,4**	**1,1**

Table/Cuadro/Tabelle 2.2

Type of fire service calls in the cities of the World in 2023
Tipo de operación en grandes ciudades del mundo en 2023
Struktur der Feuerwehreinsätze in den Großstädten der Welt im Jahr 2023

№	City	Population thous.inh.	Total number of calls a year …									
			fires	in %	accidents	in %	medical aid	in %	false calls	in %	other	in %
	Ciudad	Habitantes en miles	Total de operaciones por año									
			incendio	en %	accidentes	en %	Asist. médica	en %	Falsas Alarmas	en %	otros	in %
	Stadt	Einwohner in 1000	Anzahl der Einsätze je Jahr ...									
			zu Bränden	in %	zu Havarien	in %	Medizin. Hilfe	in %	Fehl-einsätze	in %	Sonstiges	in %
1	Istanbul	15 910	24 285	19,8	39 220	32,0	59 039	48,2	-	-	-	-
2	Moscow	12 600	6 378	9,2	3 159	4,6	-	-	18 312	26,4	41 451	59,8
3	Hong Kong	7 413	36 103	4,3	25 529	3,0	775 625	92,6	14 104	1,7	1 130	0,1
4	Athens	3 074	5 614	23,4	5 161	21,6	-	-	3 853	16,1	9 317	38,9
5	Kyiv	2 887	3 584	33,7	1 440	13,5	-	-	1 361	12,8	4 255	40,0
6	Toronto	2 800	38 267	20,7	20 679	11,2	118 084	63,9	-	-	7 811	4,2
7	Vienna	2 002	13 925	29,5	29 280	61,9	-	-	-	-	4 067	8,6
8	Montevideo	1 774	13 327	84,3	82	0,5	-	-	693	4,4	1 702	10,8
9	Prague	1 357	4 351	0,9	10 344	2,2	24 327	5,2	416 313	88,8	13 493	2,9
10	Sofia	1 290	3 532	29,0	2 172	17,8	271	2,2	375	3,1	5 836	47,9
11	Dublin	1 186	8 454	8,8	4 710	4,9	80 916	84,3	1 862	1,9	-	-
12	Stockholm	989	1 192	19,3	742	12,0	934	15,1	3 130	50,6	192	3,1
13	Zagreb	771	1 315	23,0	4 345	75,9	24	0,4	22	0,4	20	0,3
14	Copenhagen	655	1 104	18,6	111	1,9	-	-	4 340	73,3	367	6,2
15	Riga	609	2 082	30,2	3 249	47,2	-	-	1 555	22,6	-	-
16	Vilnius	563	1 083	26,2	1 281	30,9	0	0,0	11	0,3	1 765	42,6
17	Lisbon	545	2 211	16,9	4 876	37,2	270	2,1	278	2,1	5 479	41,8
18	Tallinn	453	717	11,0	1 857	28,5	-	-	3 046	46,8	889	13,7
19	Wellington	216	473	12,2	185	4,8	391	10,1	2 756	71,1	70	1,8
	∑	**57 094**	**167 997**	**8,6**	**158 422**	**8,1**	**1 059 881**	**54,2**	**472 011**	**24,1**	**97 844**	**5,0**

Table/Cuadro/Tabelle 2.3

Distribution of fires by types in the cities of the World in 2023
Distribución de incendios por tipo en grandes ciudades del mundo en 2023
Verteilung der Brände nach Objekten der Brandentstehung in den Großstädten der Welt im Jahr 2023

№	City	Population thous.inh.	Number of fires …															
			structure fires						vehicles	in %	forests	in %	grass, brush	in %	rubbish	in %	other	in %
			residential	in %	others	in %	all	in %										
	Ciudad	Habitantes enmilies	Cantidad de incendios …															
			Incendios estructurales						Vehículos	en %	forestales	en %	pastizales matorrale	en %	basura	en %	otros	en %
			residencial	en %	otros	en %	todos	en %										
	Stadt	Einwohner in 1000	Anzahl der Brände …															
			in Gebäuden						Transport	in %	im Wald	in %	Gras usw.	in %	Abfall, Müll	in %	Sonstige	in %
			Wohnung	in %	andere	in %	alle	in %										
1	Moscow	12 600	2 736	42,9	1 296	20,3	4 032	63,2	824	12,9	-	-	18	0,3	1 504	23,6	-	-
2	Hong Kong	7 413	1 136	22,7	2 133	42,6	2 853	65,3	222	4,4	-	-	664	13,3	-	-	848	16,9
3	St. Petersburg	5 380	1 964	23,3	558	6,6	2 522	29,9	-	-	-	-	-	-	-	-	5 902	70,1
4	Athens	3 074	-	-	-	-	1 693	30,2	483	8,6	78	1,4	86	1,5	291	5,2	2 983	53,1
5	Kyiv	2 887	1 093	32,7	147	4,4	1 240	37,1	225	6,7	74	2,2	1 432	42,9	1	0,0	368	11,0
6	Vienna	2 002	-	-	-	-	5 256	91,7	168	2,9	-	-	305	5,3	-	-	-	-
7	Astana	1 544	251	39,7	173	27,4	424	67,1	208	32,9	-	-	-	-	-	-	-	-
8	Prague	1 357	371	17,9	173	8,4	544	26,3	212	10,2	50	2,4	5	0,2	931	45,0	329	15,9
9	Sofia	1 290	334	9,5	48	1,4	382	10,8	261	7,4	4	0,1	474	13,4	1 717	48,6	694	19,6
10	Dublin	1 186	1 065	21,4	260	5,2	1 325	26,6	664	13,3	-	-	151	3,0	2 842	57,0	3 472	41,8
11	Stockholm	989	353	32,2	201	18,3	554	50,5	149	13,6	194	17,7	72	6,6	128	11,7	95	8,5
12	Zagreb	771	62	5,0	571	46,1	633	51,1	128	10,3	-	-	114	9,2	364	29,4	76	6,3
13	Copenhagen	655	207	28,6	164	22,7	371	51,3	53	7,3	1	0,1	72	10,0	226	31,3	21	3,1
14	Riga	609	36	1,8	970	48,6	1 006	50,4	170	8,5	104	5,2	183	9,2	533	26,7	86	4,5
15	Vilnius	563	70	6,5	220	20,5	290	27,0	138	12,8	21	2,0	138	12,8	384	35,8	103	9,6
16	Lisbon	545	1 039	47,0	269	12,2	1 308	59,2	160	7,2	13	0,6	122	5,5	287	13,0	321	14,5
17	Tallinn	453	129	17,9	57	7,9	186	25,8	60	8,3	118	16,4	-	-	277	38,5	79	11,0
18	Wellington	216	-	-	-	-	226	47,8	34	7,2	28	5,9	-	-	97	20,5	88	18,6
∑		**43 534**	**10 846**	**20,9**	**7 240**	**14,0**	**18 086**	**34,9**	**4 159**	**8,0**	**685**	**1,3**	**3 836**	**7,4**	**9 582**	**18,5**	**15 465**	**29,8**

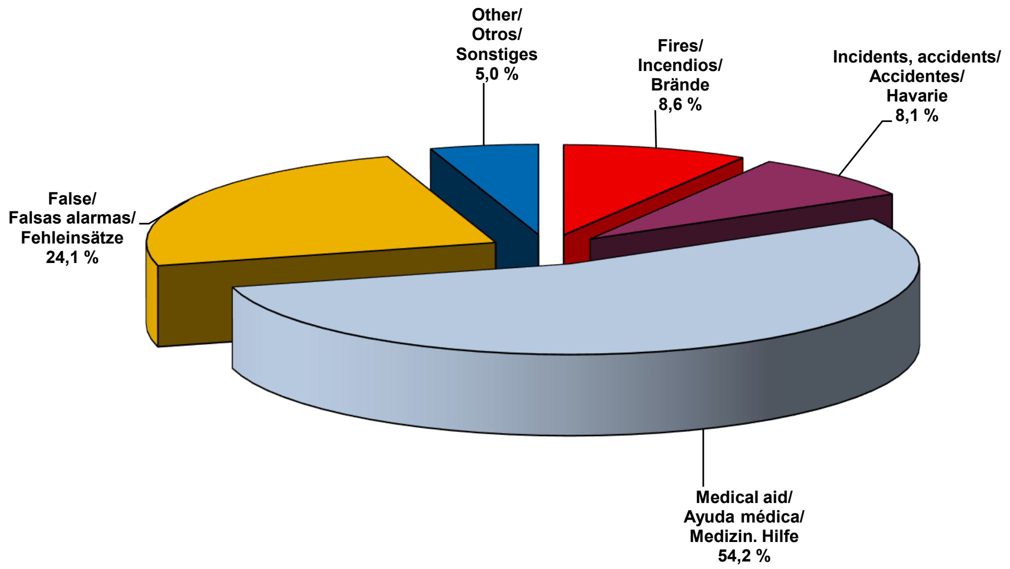


Fig. 2.5: Type of fire service calls in the cities (2023)
Fig. 2.5: Estructura de operaciones en ciudades (2023)
Bild 2.5: Struktur der Feuerwehreinsätze in den Städten (2023)

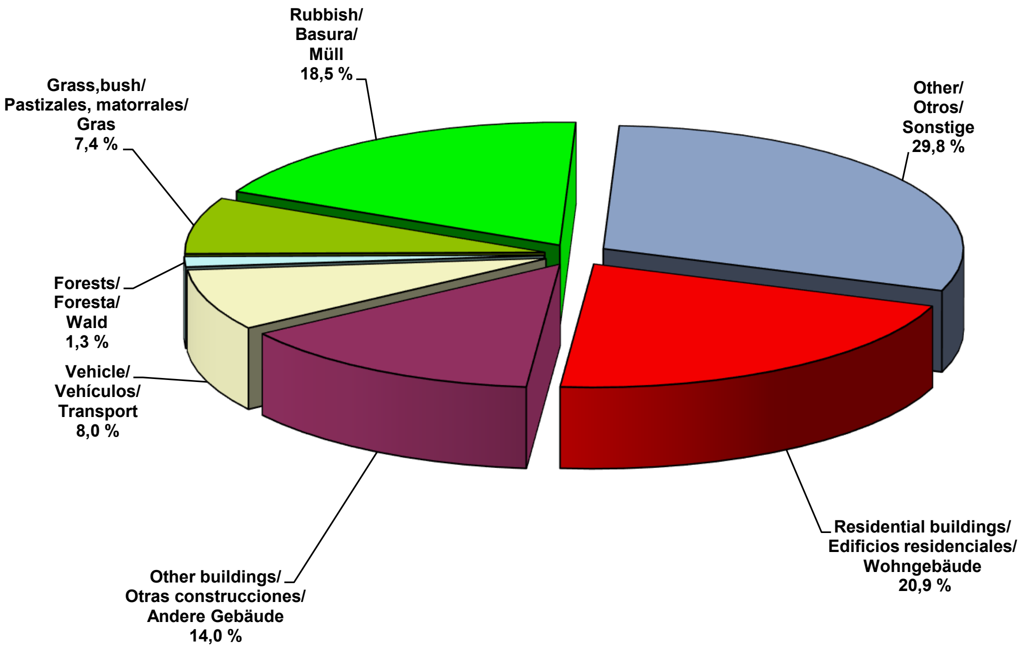


Fig. 2.6: Distribution of fires by types in the cities (2023)
Fig. 2.6: Distribución de incendios por tipos en ciudades (2023)
Bild 2.6: Brände nach Objekten der Brandentstehung in den Städten (2023)

Table/Cuadro/Tabelle 2.4

Distribution of fire deaths by types in the cities of the World in 2023
Distribución de fallecidos según el origen del incendio en ciudades del mundo en 2023
Verteilung der Brändtote nach Objekten der Brandentstehung in den Städten im Jahr 2023

№	City	Population, thous.inh.	Number of fire deaths							
			structure fires				vehicles	in %	other	in %
			residential	in %	all others	in %				
	Ciudad	Habitantes en miles	Cantidad de fallecidos							
			Incendio estructural				vehículos	en %	otros	en %
			residencial	en %	otros	en %				
	Stadt	Einwohner in 10000	Anzahl der Brandtoten							
			in Gebäuden				Transport	in %	Sonstige	in %
			Wohnung	in %	alle anderen	in %				
1	Moscow	12 600	128	84,8	14	9,3	-	-	9	6,0
2	St. Petersburg	5 380	115	87,1	11	8,3	-	-	6	4,5
3	Kyiv	2 887	39	60,9	14	21,9	1	1,6	10	15,6
4	Astana	1 544	12	50,0	8	33,3	4	16,7	0	0,0
5	Prague	1 357	5	55,6	1	11,1	0	0,0	3	33,3
6	Sofia	1 290	13	100,0	0	0,0	0	0,0	0	0,0
7	Stockholm	989	6	100,0	0	0,0	0	0,0	0	0,0
8	Zagreb	771	0	0,0	2	100,0	0	0,0	0	0,0
9	Copenhagen	655	5	100,0	0	0,0	0	0,0	0	0,0
10	Riga	609	2	13,3	12	80,0	1	6,7	0	0,0
11	Vilnius	563	4	30,8	6	46,2	0	0,0	3	23,1
12	Lisbon	545	2	100,0	0	0,0	0	0,0	0	0,0
13	Tallinn	453	9	100,0	0	0,0	0	0,0	0	0,0
	∑	**29 643**	**340**	**76,4**	**68**	**15,3**	**6**	**1,3**	**31**	**7,0**

Table/Cuadro/Tabelle 2.5

Distribution of fire injuries by types in the cities of the World in 2022
Distribución de lesionados según el origen del incendio en ciudades del mundo en 2022
Verteilung der Verletzten nach Objekten der Brandentstehung in den Städten im Jahr 2022

№	City	Population, thous.inh.	Number of fire injuries							
			structure fires				vehicles	in %	other	in %
			residential	in %	all others	in %				
	Ciudad	Habitante en miles	Cantidad de lesionados							
			Incendio estructural				vehículos	en %	otros	en %
			residencial	en %	otros	en %				
	Stadt	Einwohner in 10000	Anzahl der Verletzten							
			in Gebäuden				Transport	in %	Sonstige	in %
			Wohnung	in %	alle anderen	in %				
1	Moscow	12 600	340	83,1	69	16,9	-	-	0	0,0
2	Astana	1 544	25	89,3	2	7,1	1	3,6	0	0,0
3	Prague	1 357	58	56,9	17	16,7	6	5,9	21	20,6
4	Sofia	1 290	19	82,6	0	0,0	2	8,7	2	8,7
5	Stockholm	989	89	98,9	1	1,1	0	0,0	0	0,0
6	Zagreb	771	0	0,0	28	90,3	0	0,0	3	9,7
7	Riga	609	0	0,0	100	96,2	2	1,9	2	1,9
8	Vilnius	563	2	8,3	19	79,2	1	4,2	2	8,3
9	Lisbon	545	232	81,7	42	14,8	4	1,4	6	2,1
10	Tallinn	453	24	100,0	0	0,0	0	0,0	0	0,0
	∑	**20 721**	**789**	**70,5**	**278**	**24,8**	**16**	**1,4**	**36**	**3,2**

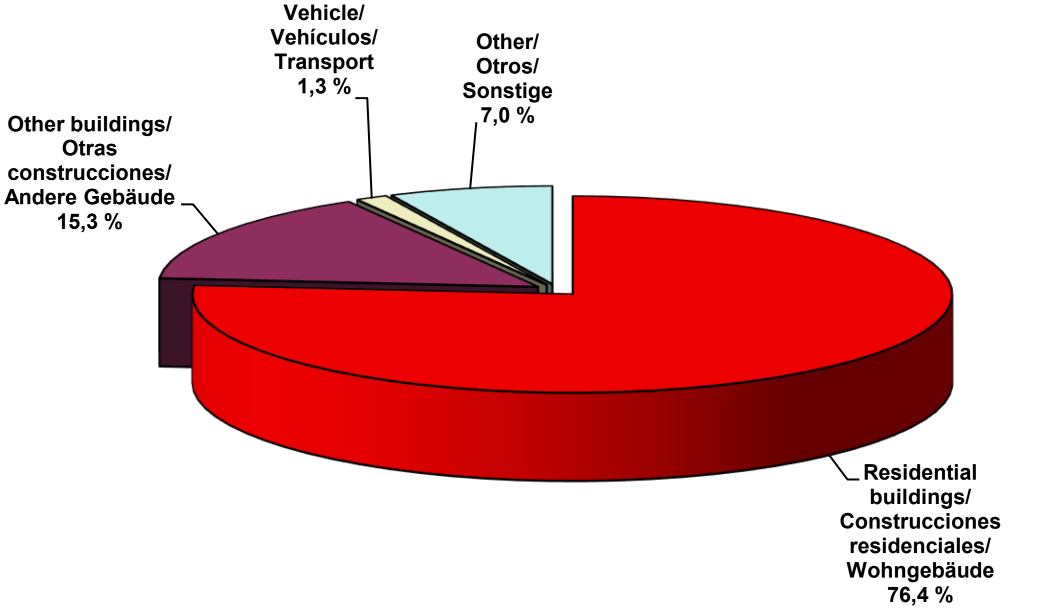


Fig. 2.7: Distribution of fire deaths by types in the cities (2023)
Fig. 2.7: Distribución de fallecidos según tipo mde incendio en ciudades (2023)
Bild 2.7: Verteilung der Brandtoten nach Objekten der Brandentstehung in den Städten (2023)

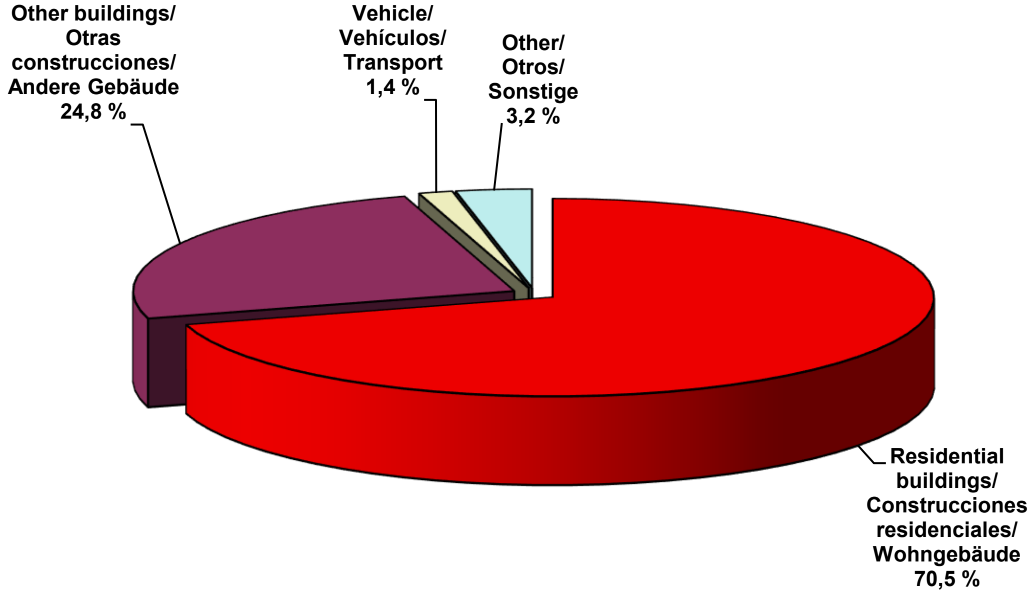


Fig. 2.8: Distribution of fire injuries by types in the cities (2023)
Fig. 2.8: Distribución de lesionados según tipo de construcción en ciudades (2023)
Bild 2.8: Verteilung der Brandverletzten nach Objekten der Brandentstehung in den Städten (2023)

Table/Cuadro/Tabelle 2.6

Trends in calls in the cities of the World in 2019-2023
Dinámica de las opetraciones en ciudades del mundo período 2019-2023
Dynamik der Einsätze in den Großstädten der Welt für 2019-2023

№	City	Population, thous. inh.	Number of calls					Average:	
			2019	2020	2021	2022	2023	per year	per 1000 inh.
	Ciudad	Habitantes en miles	Cantidad de operaciones					Promedio	
			2019	2020	2021	2022	2023	por año	por 1000 hab
	Stadt	Einwohner, in 1.000	Gesamtanzahl der Einsätze in …					Mittelwert je	
			2019	2020	2021	2022	2023	Jahr	1.000 Einw.
1	Dhaka	21 741	5 940	4 551	-	9 987	-	6 826	0,3
2	Istanbul	15 910	63 284	63 087	136 510	143 775	122 544	105 840	6,7
3	Tokyo	14 010	991 278	997 765	942 125	1 036 745	-	991 978	70,8
4	Manila	13 804	5 589	4 900	-	-	-	5 245	0,4
5	Moscow	12 600	50 211	67 106	78 962	69 842	69 300	67 084	5,3
6	Lima	10 719	63 053	38 163	-	-	-	50 608	4,7
7	Jakarta	10 562	-	38 000	-	-	-	38 000	3,6
8	London	9 726	105 034	98 581	109 590	125 392	126 464	113 012	11,6
9	Seoul	9 384	638 205	1 931 834	-	2 118 775	-	1 562 938	166,6
10	Ho Chi Minh	9 000	-	-	1 308	-	-	1 308	0,1
11	Hanoi	8 499	-	937	1 246	1 325	-	1 169	0,1
12	Hong Kong	7 509	833 300	706 226	786 261	810 219	810 218	789 245	105,1
13	Paris	7 019	-	417 466	463 851	498 162	-	459 826	65,5
14	Bangkok	5 591	44 965	49 441	-	58 256	-	50 887	9,1
15	St. Petersburg	5 380	75 251	-	-	-	43 488	59 370	11,0
16	Berlin	3 755	478 281	470 238	479 008	492 604	-	480 033	127,8
17	Athens	3 074	19 452	17 030	20 661	24 035	18 784	19 992	6,5
18	Kyiv	2 887	19 355	16 477	16 383	9 278	10 640	14 427	5,0
19	Rome	2 806	61 656	-	-	-	-	61 656	22,0
20	Toronto	2 800	134 429	124 547	134 539	169 784	184 841	149 628	53,4
21	Taipei	2 602	136 403	131 474		-	-	133 939	51,5
22	Bucharest	2 162	-	103 158	118 717	-	-	110 938	51,3
23	Minsk	2 021	10 285	-	-	-	-	10 285	5,1
24	Vienna	2 002	36 489	35 617	41 273	43 030	47 272	40 736	20,3
25	Warsaw	1 861	17 726	21 085	19 941	21 539	-	20 073	10,8
26	Hamburg	1 857	264 370	257 280	-	316 275	-	279 308	150,4
27	Montevideo	1 774	9 904	18 604	15 762	17 376	16 313	15 592	8,8
28	Budapest	1 758	18 868	12 485	12 504	18 527	-	15 596	8,9
29	Astana	1 544	3 993	3 904	-	3 000	3 000	3 474	2,3
30	Ulaanbaatar	1 540	-	-	-	1 827	-	1 827	1,2
31	Prague	1 357	353 353	321 680	325 208	384 176	468 828	370 649	273,1
32	Milan	1 350	47 052	-		-	-	47 052	34,9
33	Sofia	1 290	12 203	8 699	9 195	10 905	12 186	10 638	8,2
34	Brussels	1 222	-	14 707	14 386	16 455	-	15 183	12,4
35	Dublin	1 186	94 970	-	94 777	99 243	95 942	96 233	81,1
36	Stockholm	989	6 864	5 904	-	-	6 190	6 319	6,4
37	Naples	972	40 424	-	-	-	-	40 424	41,6
38	Zagreb	767	3 968	8 635	4 086	3 341	-	5 008	6,5
39	Helsinki	656	-	-	7 780	-	-	7 780	11,9
40	Copenhagen	655	-	4 948	-	5 835	5 922	5 568	8,5
41	Riga	609	6 231	6 390	-	6 885	6 886	6 598	10,8
42	Baltimore	593	354 772	-	-	-	-	354 772	598,3
43	Vilnius	563	3 741	3 546	3 577	3 601	4 030	3 699	6,6
44	Lisbon	545	-	-	-	22 045	13 114	17 580	32,3
45	Tallinn	453	6 236	-	6 340	6 378	6 527	6 370	14,1
46	Bratislava	441	-	-	11 923	-	-	11 923	27,0
47	Ljubljana	284	43 131	6 091	2 952	-	-	17 391	61,2
48	Wellington	216	4 888	4 660	-	4 410	4 416	4 594	21,3
49	Bern	143	-	2 338	-	-	-	2 338	16,3
	∑	**210 188**	**5 065 154**	**6 017 554**	**3 858 865**	**6 553 027**	**2 076 905**	**4 714 301**	**22,4**

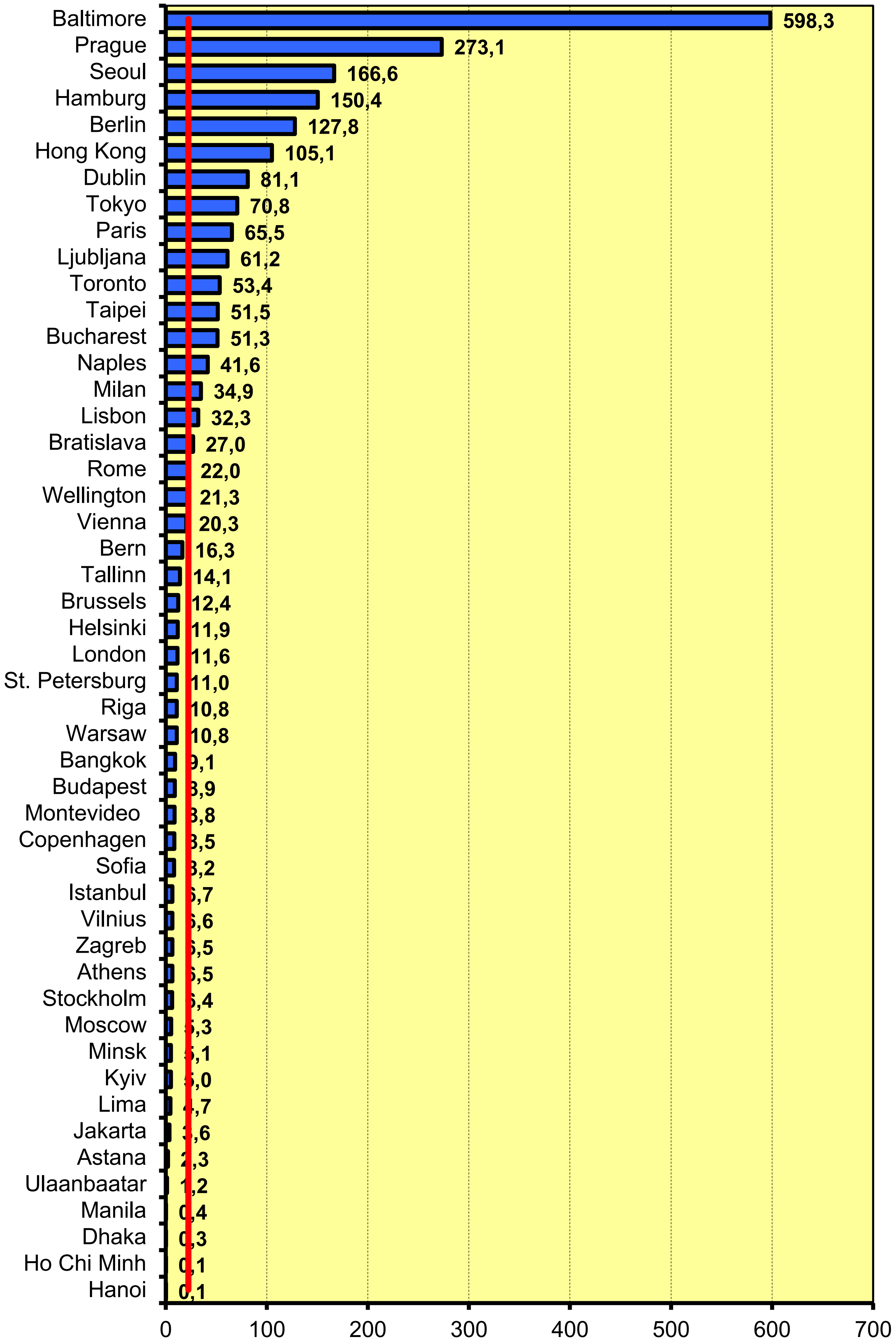


Fig . 2.1: Average number of calls per 1000 inh. (2019-2023)
Fig . 2.1: Promedio de operaciones por 1.000 hab. (2019-2023)
Bild 2.1: Mittlere Einsatzanzahl je 1000 Einwohner (2019-2023)

Table/Cuadro/Tabelle 2.7

Trends in fires in the cities of the World in 2019-2023
Dinámica de los incendios en ciudades del mundo período 2019-2023
Dynamik der Brände in den Großstädten der Welt für 2019-2023

№	City / Ciudad / Stadt	Population, thous. inh. / Población en miles / Einwohner, in 1000	Number of fires / Cantidad de incendios / Gesamtanzahl der Brände in … 2019	2020	2021	2022	2023	Average: per year / Promedio por año / Mittelwert je Jahr	Average: per 1000 inh. / por 1000 hab / 1000 Einw.
1	Delhi	26 495	31 157	25 709	27 343	31 958	-	29 042	1,1
2	Dhaka	22 478	3 258	2 541	-	5 984	-	3 928	0,2
3	Beijing	21 895	3 040	7 106	7 490	6 843	5 856	6 067	0,3
4	Cairo	21 750	7 114	6 887	6 132	5 840	5 993	6 393	0,3
5	Istanbul	15 910	22 546	20 584	20 760	22 554	24 285	22 146	1,4
6	Tehran	14 000	26 829	29 433	-	-	-	28 131	2,0
7	Manila	13 804	4 768	4 416	3 315	2 904	-	3 851	0,3
8	Tokyo	13 677	4 120	3 721	3 939	5 087	4365	4 246	0,3
9	Moscow	12 600	9 687	7 834	7 413	6 927	6 378	7 648	0,6
10	Lima	10 800	7 007	6 162	-	6 323	6 669	6 540	0,6
11	Jakarta	10 562	2 183	1 505	-	-	-	1 844	0,2
12	London	9 726	17 993	17 411	14 929	19 297	16 120	17 150	1,8
13	Seoul	9 384	5 881	5 088	31 515	38 269	5 671	17 285	1,8
14	Ho Chi Minh	9 000	342	290	374	200	300	301	0,0
15	Hanoi	8 499	864	415	355	586	977	639	0,1
16	Hong Kong	7 509	37 606	33 682	33 891	34 775	36 103	35 211	4,7
17	Paris	7 019	-	12 947	10 724	11 838	15 546	12 764	1,8
18	Bangkok	5 590	-	489	-	2 707	-	1 598	0,3
19	St. Petersburg	5 380	11 006	9 932	9 610	9 781	8 224	9 711	1,8
20	Alexandria	4 388	3 516	3 480	3 293	3 355	2 820	3 293	0,8
21	Berlin	3 755	6 688	8 493	6 843	9 578	9 584	8 237	2,2
22	Dubai	3 331	329	-	-	-	-	329	0,1
23	Athens	3 074	4 950	4 660	4 382	5 931	5 614	5 107	1,7
24	Kyiv	2 887	5 878	5 084	4 875	2 869	3 584	4 458	1,5
25	Toronto	2 800	35334	32403	32283	36975	38267	35 052	12,5
26	Taipei	2 650	5 484	5 640	-	-	-	5 562	2,1
27	Damascus	2 503	-	-	1 853	940	-	1 397	0,6
28	Bucharest	2 162	-	2 554	2 022	-	1 650	2 075	1,0
29	Haiphong	2 028	119	-	-	-	-	119	0,1
30	Minsk	2 021	305	303	296	339	328	314	0,2
31	Vienna	2 002	11 255	10 570	11 343	12 197	13 925	11 858	5,9
32	Warsaw	1 861	4 455	3 380	3 239	3 810	3 909	3 759	2,0
33	Hamburg	1 857	11 972	10 952	10 513	12 058	12 380	11 575	6,2
34	Montevideo	1 774	6 243	14 536	11 802	12 486	13 327	11 679	6,6
35	Budapest	1 758	1 853	2 115	2 135	2 232	-	2 084	1,2
36	Astana	1 544	717	650	718	831	632	710	0,5
37	Ulaanbaatar	1 540	2 817	1 782	-	1 755	-	2 118	1,4
38	Muscat	1 421	1 330	1 046	1 353	1 307	1 464	1 300	0,9
39	Prague	1 357	1 998	1 797	1 795	2 326	4 351	2 453	1,8
40	Da Nang	1 353	245	170	-	-	-	208	0,2
41	Sofia	1 290	4 222	3 288	3 273	3 440	3 532	3 551	2,8
42	Brussels	1 222	-	3 491	3 304	3 891	1 095	2 945	2,4
43	Dublin	1 186	9 150	9 740	9 671	9 087	8 454	9 220	7,8
44	Yerevan	1 084	-	2 486	-	-	-	2 486	2,3
45	Stockholm	989	1 750	1 425	-	-	1 192	1 456	1,5
46	Zagreb	767	1 483	1 330	1 334	1 612	1 315	1 415	1,8
47	Frankfurt Main	759	1 730	1 539	-	-	-	1 635	2,2
48	Helsinki	656	-	776	795	-	-	786	1,2
49	Copenhagen	655	-	1 072	-	864	1 104	1 013	1,5
50	Riga	609	2 271	1 946	1 748	1 915	2 082	1 992	3,3
51	Vilnius	563	1 481	1 150	1 058	1 022	1 083	1 159	2,1
52	Lisbon	545	-	-	-	1 132	2 211	1 672	3,1
53	Tallinn	453	1 049	880	895	816	717	871	1,9
54	Bratislava	441	-	-	683	-	-	683	1,5
55	Ljubljana	284	1 179	1 007	1 001	-	-	1 062	3,7
56	Wellington	216	765	738	-	291	473	567	2,6
∑		**305 863**	**325 969**	**336 635**	**300 297**	**344 932**	**271 580**	**315 883**	**1,0**

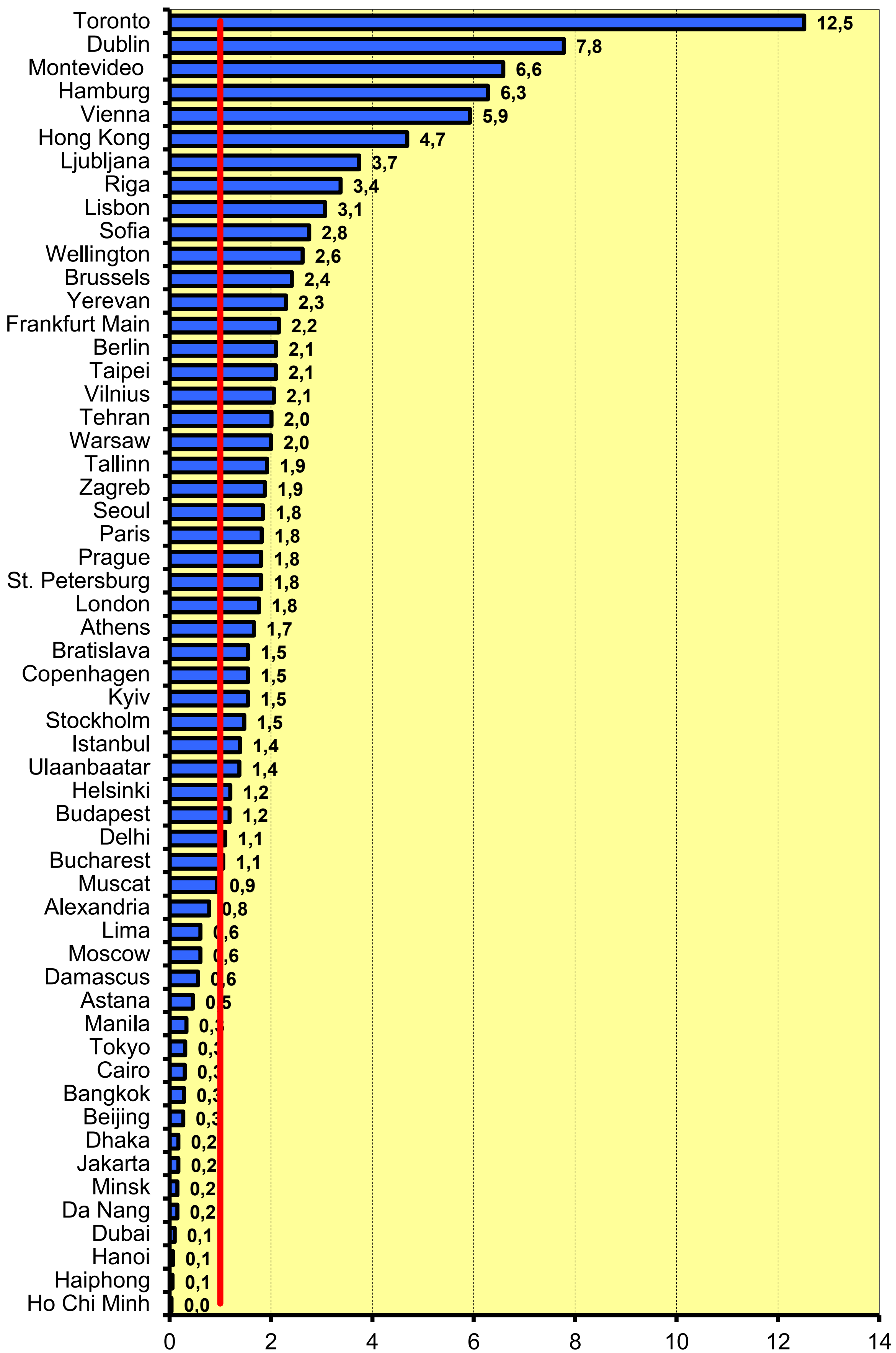


Fig. 2.2: Average number of fires in cities per 1000 inh. (2019-2023)
Fig. 2.2: Promedio de incendios en ciudades por 1.000 hab. (2019-2023)
Bild 2.2: Mittlere Brandanzahl je 1000 Einwohner in Städten (2019-2023)

Table/Cuadro/Tabelle 2.8

Trends in fire deaths in the cities of the World in 2019-2023
Dinámica de los fallecidos en incendios en ciudades años 2019-2023
Dynamik der Brandtotenzahlen in den Stadten für 2019-2023

№	City	Population, thous. inh.	Number of fire deaths, inh.					Average number of fire deaths:		
			2019	2020	2021	2022	2023	per year	per 100000 inh.	per 100 fires
	Ciudad	Habitantes, en miles	Fallecidos en incendios, hab.					Promedio de fallecidos		
			2019	2020	2021	2022	2023	por año	por 100000 hab.	por 100 incendios
	Stadt	Einwohner, in 1000	Anzahl der Brandtoten					Mittelwert je:		
			2019	2020	2021	2022	2023	Jahr	100000 Einw.	100 Brände
1	Delhi	26 495	308	346	591	1 029	-	569	2,1	2,0
2	Dhaka	22 478	87	14	-	22	-	41	0,2	1,0
3	Beijing	21 895	27	43	59	62	89	56	0,3	0,9
4	Cairo	21 750	-	16	24	36	38	29	0,1	0,4
5	Tehran	14 000	26	50	-	-	-	38	0,3	0,1
6	Manila	13 804	85	57	-	-	-	71	0,5	1,8
7	Tokyo	13 677	108	86	86	91	88	92	0,7	2,2
8	Moscow	12 600	166	146	183	174	151	164	1,3	2,1
9	Jakarta	10 562	27	18	-	-	-	23	0,2	1,2
10	London	9 726	37	30	50	33	-	38	0,4	0,2
11	Seoul	9 384	37	37	-	37	24	34	0,4	0,2
12	Ho Chi Minh	9 000	11	12	26	9	12	14	0,2	4,6
13	New York City	8 550	66	-	-	-	104	85	1,0	-
14	Hanoi	8 499	20	6	12	75	71	37	0,4	5,8
15	Hong Kong	7 509	14	24	23	28	31	24	0,3	0,1
16	Paris	7 019	-	27	29	37	-	31	0,4	0,2
17	Bangkok	5 591	16	6	-	12	-	11	0,2	0,7
18	St. Petersburg	5 380	133	133	135	131	132	133	2,5	1,4
19	Berlin	3 755	31	17	16	-	-	21	0,6	0,3
20	Madrid	3 166	15	-	-	22	-	19	0,6	-
21	Athens	3 074	3	13	13	10	14	11	0,3	0,2
22	Kyiv	2 887	60	51	72	68	64	63	2,2	1,4
23	Toronto	2 800	12	20	19	13	14	16	0,6	0,0
24	Taipei	2 602	15	23	-	28	-	22	0,8	0,4
25	Damascus	2 503	-	-	3	80	-	42	1,7	3,0
26	Bucharest	2 162	-	17	22	-	9	16	0,7	0,8
27	Haiphong	2 053	1	1	-	-	-	1	0,0	0,8
28	Minsk	2 021	24	-	-	-	-	24	1,2	7,6
29	Warsaw	1 861	10	13	20	8	19	14	0,8	0,4
30	Hamburg	1 857	8	8	15	15	10	11	0,6	0,1
31	Montevideo	1 774	40	21	22	70	53	41	2,3	0,4
32	Budapest	1 758	17	12	14	12	-	14	0,8	0,7
33	Astana	1 544	15	22	0	21	12	14	0,9	2,0
34	Ulaanbaatar	1 540	21	35	-	19	-	25	1,6	1,2
35	Prague	1 357	11	13	12	8	9	11	0,8	0,4
36	Da Nang	1 353	1	0	-	-	-	1	0,0	0,2
37	Sofia	1 290	21	11	23	33	13	20	1,6	0,6
38	Brussels	1 222	-	-	7	8	2	6	0,5	0,2
39	Dublin	1 186	1	7	1	4	1	3	0,2	0,0
40	Yerevan	1 084	-	3	-	-	-	3	0,3	0,1
41	Stockholm	989	5	8	-	-	6	6	0,6	0,4
42	Zagreb	767	2	1	3	4	2	2	0,3	0,2
43	Helsinki	656	-	-	1	-	-	1	0,2	0,1
44	Copenhagen	655	-	5	-	5	5	5	0,8	0,5
45	Riga	609	16	24	-	25	15	20	3,3	1,0
46	Vilnius	563	7	3	11	4	13	8	1,3	0,7
47	Lisbon	545	-	-	-	2	2	2	0,4	0,1
48	Tallinn	453	2	8	6	3	9	6	1,2	0,6
49	Bratislava	441	-	-	3	-	-	3	0,7	0,4
50	Ljubljana	284	0	0	0	-	-	0	0,0	0,0
51	Wellington	216	0	0	-	0	1	0	0,1	0,0
	∑	**278 946**	**1 506**	**1 387**	**1 501**	**2 238**	**1 013**	**1 529**	**0,5**	**0,5**

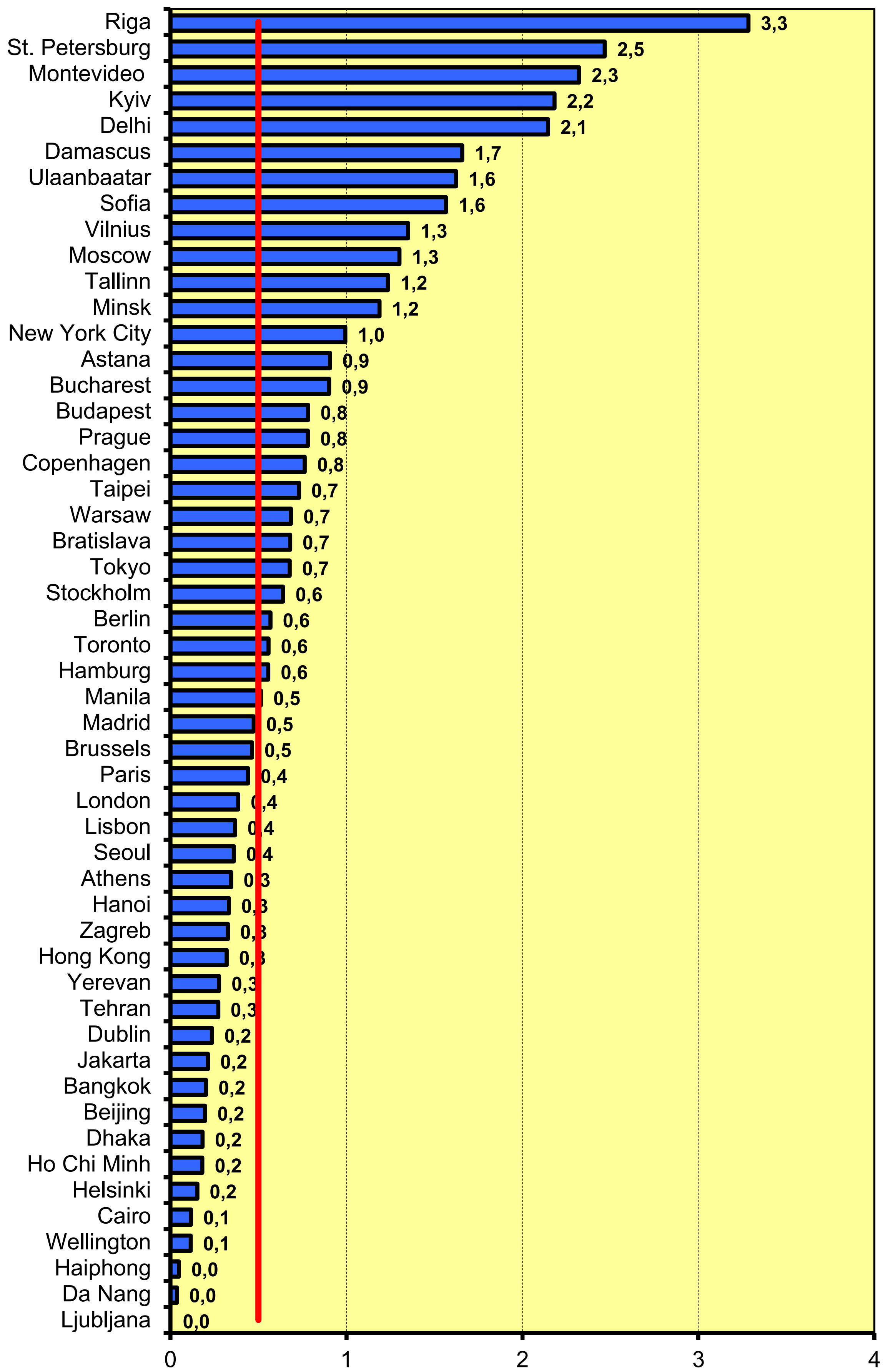


Fig. 2.3: Average number of fire deaths in cities per 100000 inh. (2019-2023)
Fig. 2.3: Promedio de fallecidos en incendios por 100.000 hab. (2019-2023)
Bild 2.3: Mittlere Brandtotenanzahl je 100000 Einw. in Städten (2019-2023)

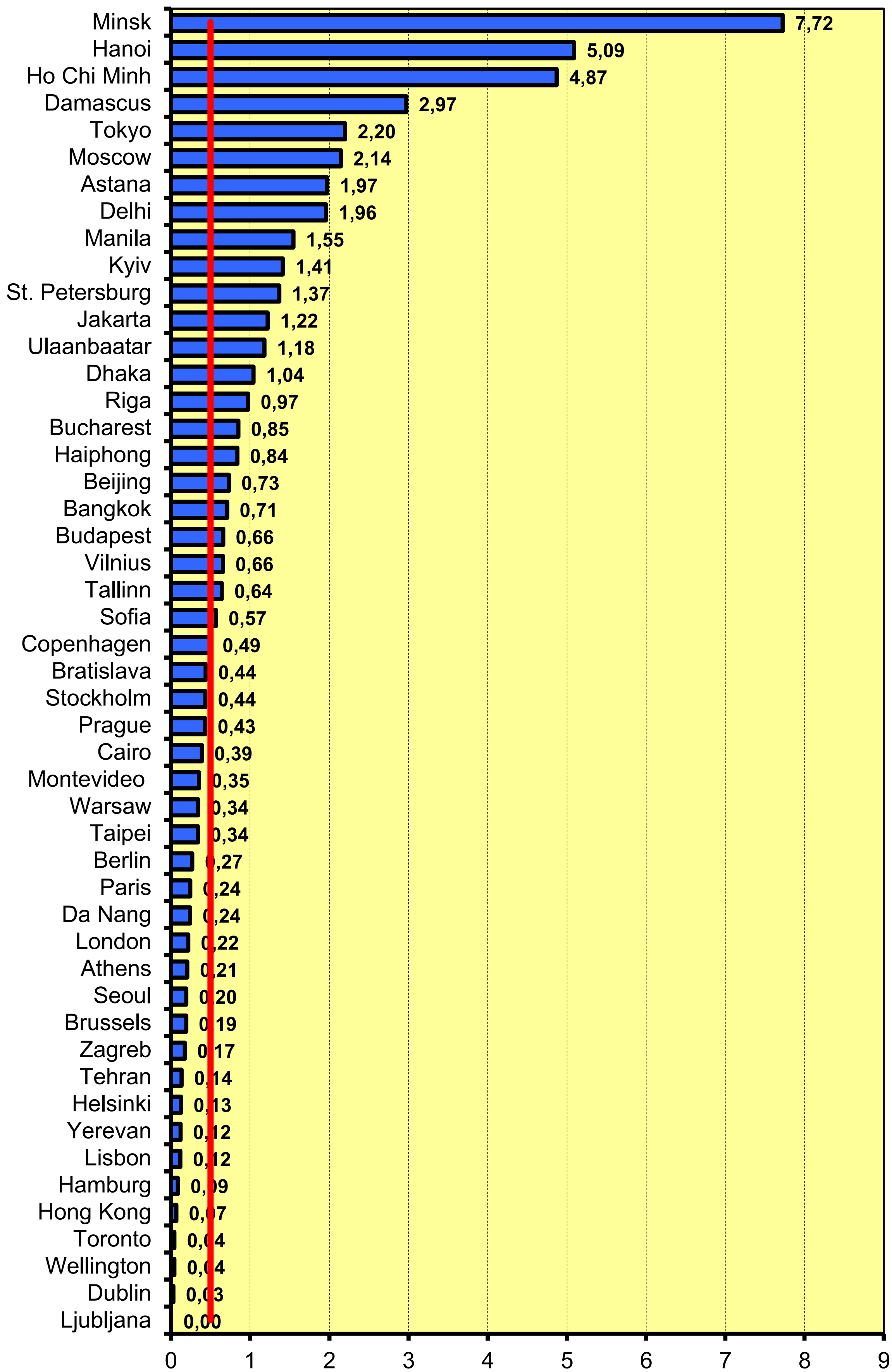


Fig. 2.4: Average number of fire deaths per 100 fires (2019-2023)
Fig. 2.4: Promedio de fallecidos por 100 incendios (2019-2023)
Bild 2.4: Mittlere Brandtotenzahlen je 100 Brände in Städten (2019-2023)

Table/Cuadro/Tabelle 2.9

Statistics of fire services in the cities of the World in 2010-2023 (most recent data)
Estadísticas de personal y equipamiento en grandes ciudades del mundo años 2010-2023
Personal und Ausstattung der Feuerwehren in den Großstädten in den Jahren 2010-2023

№	City	Population, thous. inh.	Area, sq. km.	Fire stations	Number of		Number of fire fighters			
					engines	ladders	career	part time	volunt.	total
	Ciudad	Habitantes en miles	Area, km cuadrados	Estaciones Bomberos	Cantidad de		Cantidad de Bomberos			
					Bombas	Escalas	Profes.	Med. tpo.	Volunt.	total
	Stadt	Einwohner, in 1.000	Fläche, in qkm.	Feuer-wachen	Anzahl der		Personal der Feuerwehr			
					LF, TLF	DL, TM	BF	Teilzeit	FF	Gesamt
1	Delhi	26 495	1 483	66	222	14	3 616	0	0	3 616
2	Shanghai	24 644	1 600	107	-	-	-	-	-	-
3	Dhaka	22 478	1 464	17	339	15	1 713	-	-	1 713
4	Beijing	21 950	16 411	394	850	200	6 900	-	-	6 900
5	Istanbul	14 657	5 343	125	-	-	4 842	-	344	5 186
6	Tehran	14 000	750	132	361	32	5 243	-	-	5 243
7	Manila	13 804	620	142	108	-	3 616	-	-	3 616
8	Tokyo	13 677	1 769	292	673	86	18 672	1 215	21 721	41 608
9	Moscow	12 600	2 561	113	250	52	7 645	0	0	7 645
10	Jakarta	10 562	662	154	238	18	2 571	1 756	-	4 327
11	London	9 726	1 707	103	142	11	5 992	0	0	5 992
12	Seoul	9 552	605	24	124	52	7 126	0	4 382	11 508
13	New York City	8 550	834	218	198	143	11 051	-	-	11 051
14	Hanoi	8 499	3 360	26	179	32	1 106	252	-	1 358
15	Hong Kong	7 413	1 114	84	80	95	10 394	-	-	10 394
16	Paris	7 019	760	78	164	64	8 598	0	683	9 281
17	Bangkok	5 591	1 569	47	56	92	1 697	0	-	1 697
18	Damascus	5 500	400	20	23	2	690	0	0	690
19	St. Petersburg	5 380	1 436	68	180	41	4 630	0	421	5 051
20	Chicago	5 000	776	100	99	61	4 500	0	0	4 500
21	Los Angeles	4 000	1 217	106	98	48	3 586	0	0	3 586
22	Berlin	3 770	892	95	200	41	4 282	0	1 530	5 812
23	Yokohama	3 709	437	96	96	-	3 479	-	-	3 479
24	Sidney	3 600	531	75	225	15	1 800	0	0	1 800
25	Kuwait City	3 500	1 000	33	50	11	3 500	-	-	3 500
26	Madrid	3 166	608	14	45	14	1 800	0	0	1 800
27	Melbourne	3 150	811	46	100	8	1 956	60	0	2 016
28	Athens	3 074	412	27	243	17	4 705	-	834	5 539
29	Kyiv	2 887	851	29	101	31	2 030	0	11 830	13 860
30	Osaka	2 752	222	89	-	-	3 484	-	-	3 484
31	Taipei	2 622	272	44	187	34	1 873	0	1 585	3 458
32	Johannesburg	2 300	573	15	32	10	810	0	0	810
33	Bucharest	2 162	240	36	78	14	2 680	0	0	2 680
34	Havana	2 100	740	18	32	9	800	0	0	800
35	Minsk	2 021	348	32	78	33	825	-	0	825
36	Vienna	2 002	415	72	71	20	1 838	0	218	2 056
37	Kuala Lumpur	1 950	243	19	-	-	950	-	200	1 150
38	Warsaw	1 861	517	17	56	21	1 588	0	433	2 021
39	Hamburg	1 852	755	86	238	24	2 659	-	-	3 086
40	Budapest	1 758	525	20	59	12	1 726	0	832	2 558
41	Belgrade	1 659	360	19	151	5	719	0	-	719
42	Ulaanbaatar	1 515	4 704	14	32	4	696	12	6	714
43	Astana	1 444	722	12	62	26	1 600	-	-	1 600
44	Kuala Lumpur	1 401	243	13	17	4	608	0	271	879
45	Munich	1 367	310	32	79	19	1 445	-	687	2 132
46	Prague	1 357	496	62	154	25	919	-	670	1 589
47	Sofia	1 290	492	13	45	3	851	0	124	975
48	Brussels	1 222	162	8	17	13	1 101	0	0	1 101
49	Dublin	1 186	921	14	-	-	842	-	-	842
50	Yerevan	1 078	227	13	28	4	590	-	-	590
51	Cologne	1 021	405	37	32	14	1 957	-	743	2 700
52	Stockholm	989	187	9	-	-	514	41	-	555
53	Bishkek	874	169	9	34	3	384	-	-	384
54	Zagreb	767	641	65	88	8	358	-	5 822	6 180
55	Frankfurt Main	759	248	40	83	12	1 000	-	900	1 900
56	Kishinev	732	120	5	30	7	656	-	-	656
57	Helsinki	656	716	34	37	7	488	0	355	843
58	Copenhagen	655	89	7	13	7	357	16	67	440
59	Oslo	624	454	8	7	4	456	2	-	458
60	Riga	609	304	10	36	6	413	-	-	413
61	Rotterdam	600	280	15	-	-	-	-	-	-
62	Dortmund	588	280	27	54	11	748	-	707	1 455
63	Essen	587	210	26	48	10	750	0	550	1 300
64	Dusseldorf	587	217	17	56	11	890	0	294	1 184
65	Seattle	563	217	33	33	11	1 044	-	-	1 044
66	Vilnius	563	401	7	23	4	556	0	4	560
67	Bremen	547	325	26	66	7	478	0	603	1 081
68	Lisbon	545	100	11	29	8	928	-	-	928
69	Hannover	525	204	21	56	9	596	0	636	1 232
70	Bratislava	462	368	4	15	2	293	0	301	594
71	Tallinn	453	159	6	8	3	204	0	350	554
72	Brno	379	230	26	53	7	210	67	213	490
73	Ostrava	289	214	33	54	9	279	104	291	674
74	Ljubljana	284	163	38	110	3	135	0	1 076	1 211
75	Brunei Darussalam	240	570	9	5	11	644	0	1 700	2 344
76	Wellington (NZ)	216	290	11	10	2	145	0	110	255
77	Pilsen	171	138	22	16	5	138	48	189	375
	∑	**330 137**	**73 169**	**4 035**	**7 856**	**1 656**	**180 965**	**3 573**	**61 682**	**246 220**

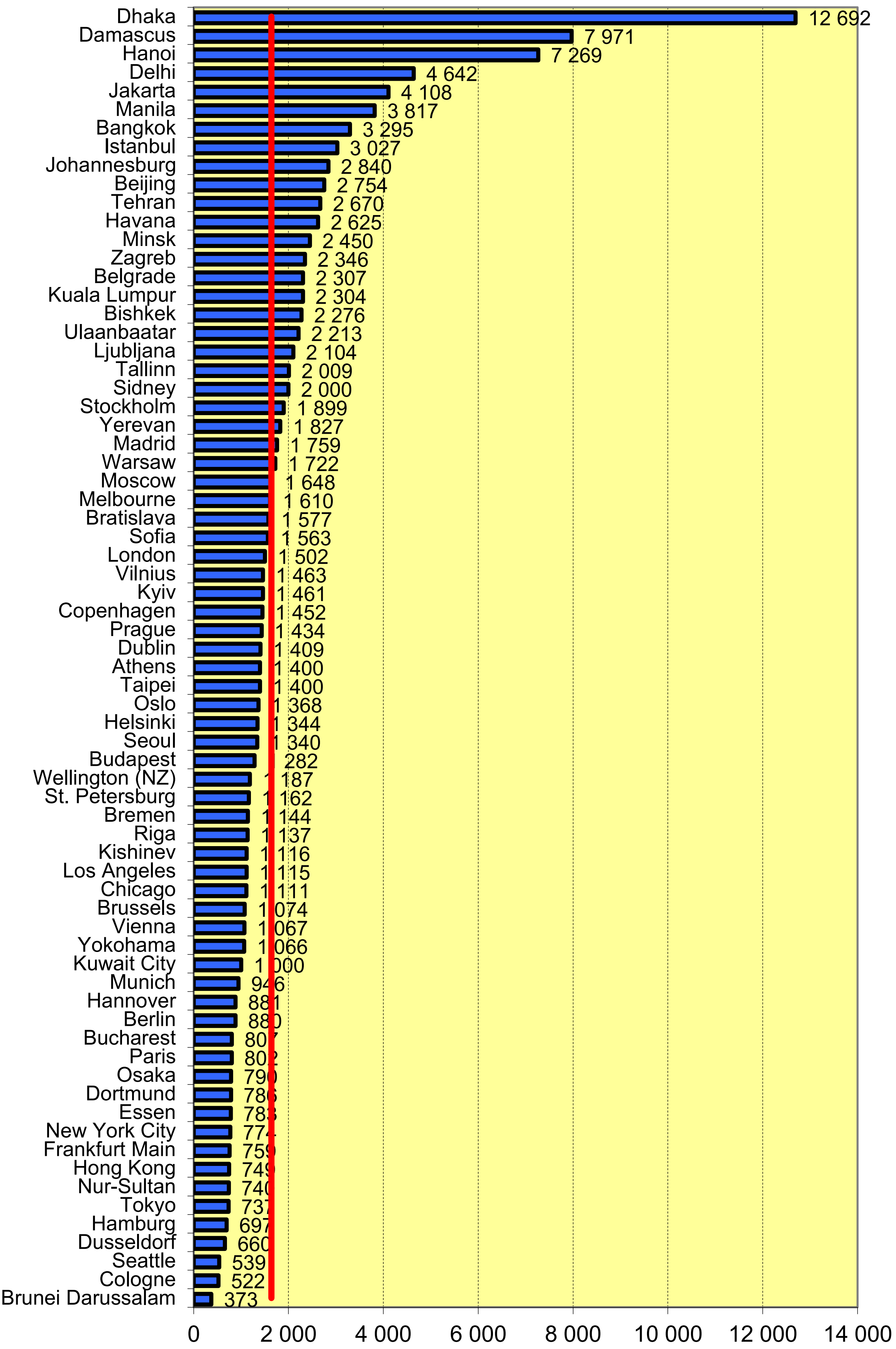


Fig. 2.9: Average number of inhabitants per 1 career firefighter
Fig. 2.9: Promedio de habitantes por 1 Bombero profesional
Bild 2.9: Mittlere Einwohneranzahl auf 1 Berufsfeuerwehrmann

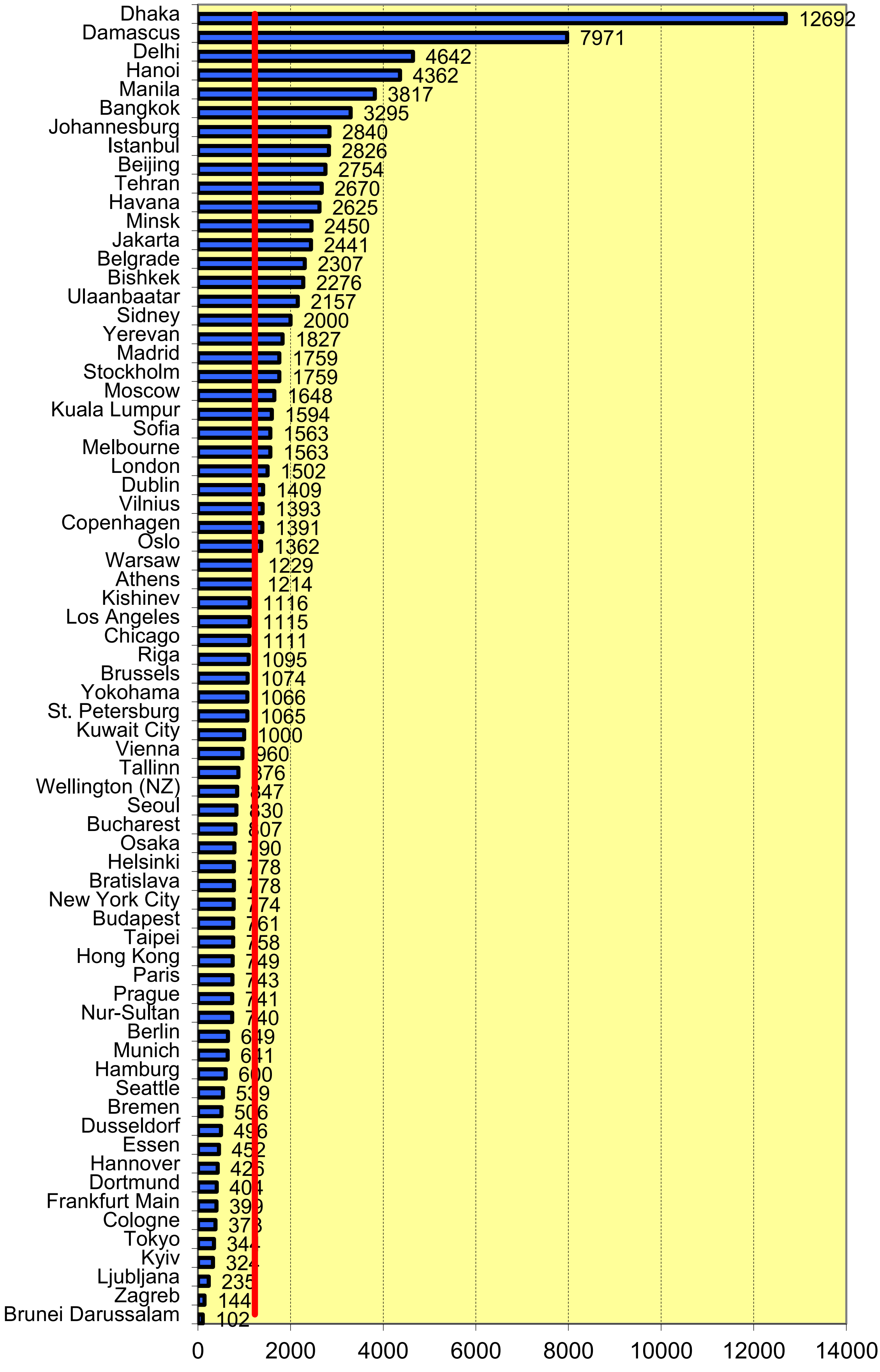


Fig. 2.10: Average number of inhabitants per 1 firefighter
Fig. 2.10: Promedio de habitantes por 1 Bombero
Bild 2.10: Mittlere Einwohneranzahl auf 1 Feuerwehrmann

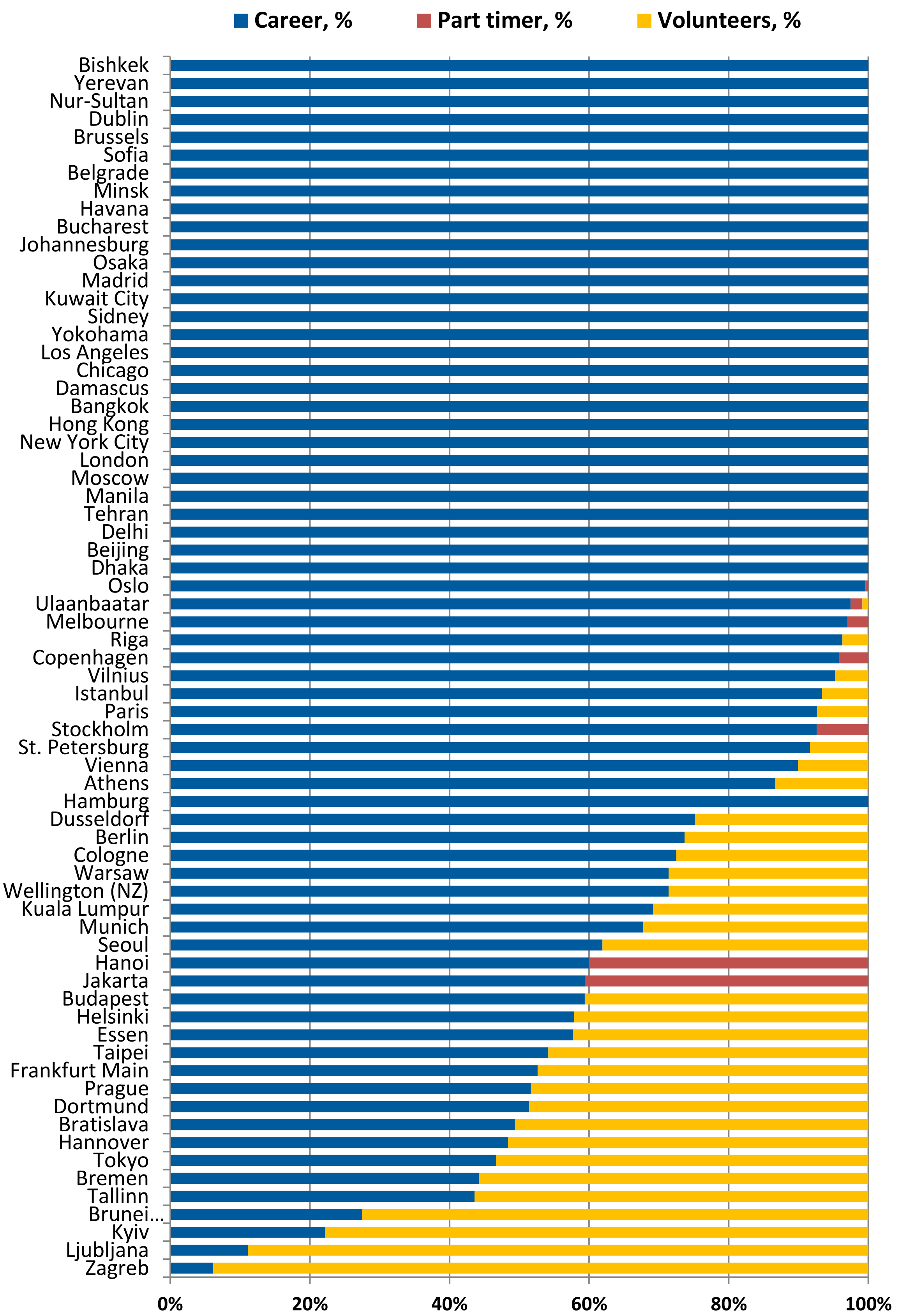


Fig. 2.11: Contributions of categories of firefighters

Fig. 2.11: Proporción de Bomberos según categoría

Bild 2.11: Anteile der Feuerwehrmannkategorien

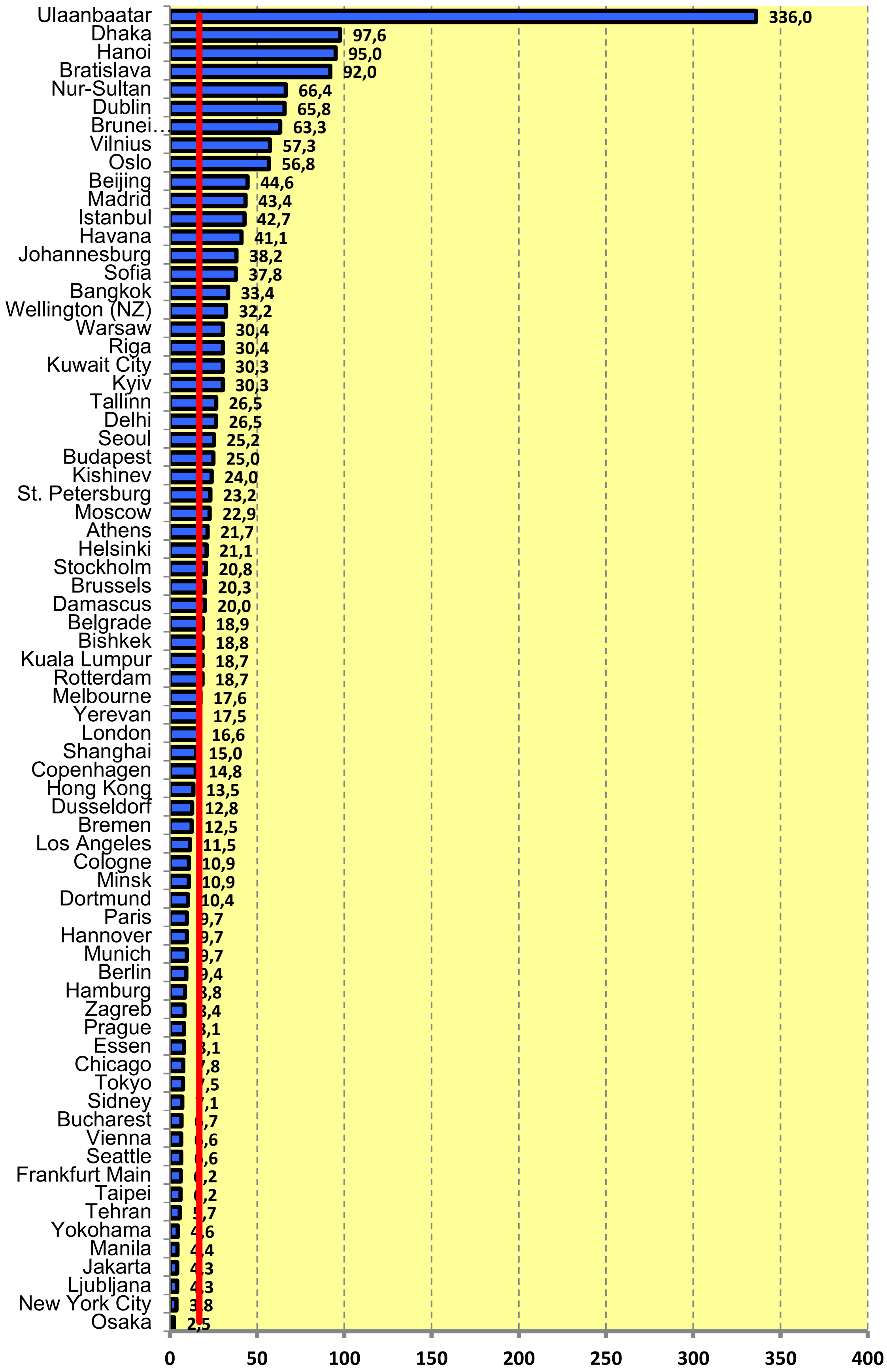


Fig. 2.12: Average response area per one fire station [sq.km]

Fig. 2.12: Area de respuesta promedio por 1 estación de Bomberos [km cuad.]

Bild 2.12: Mittlere Ausrückebereichsfläche 1 FW [qkm]

Towers on Fire - Introduction

The newsletter article "**Towers on fire** in the UAE - 2010-2012" was published on November 19, 2012. [1] This article has the following content about the timeline of high-rise building fires in the UAE:

- On June 13, 2010, two apartments were destroyed in a fire that broke out in an 11-storey building in the Tourist Club Area (TCA) in Abu Dhabi.
- On July 06, 2010, a fire broke out in a 14-storey building in the Bu Tinah area of Sharjah, spreading panic among residents.
- On August 28, 2010, about 139 people from 29 families were left homeless after a fire gutted an eight-story building on Airport Road in Abu Dhabi.
- November 08, 2011, a massive fire broke out at a high-rise residential tower in the Al Nahda area in Sharjah that left six people injured.
- December 22, 2011, two people were killed, and one person was injured in a fire that erupted in an 11th-floor flat in a building situated on Al Jawazat Street (Al Falah) at the intersection with Al Murour Street, Abu Dhabi.
- On January 25, 2012, a fire broke out in Al Baker Tower 4 near Al Tawun Mall in Sharjah. The fire was caused by a lit cigarette that was thrown off the balcony from an upper floor and landed on the balcony on the first floor.
- On April 28, 2012, hundreds of families were displaced after a massive fire broke out in the 40-storey Al Tayer Tower near Al Nahda Park in Sharjah.
- On October 06, 2012, a fire in a 13-story Saif Belhasa building in Tecom, Dubai, injured 2 people and damaged at least nine floors.
- On November 18, 2012, at around 2 a.m., a massive fire broke out at Tamweel Tower in Jumeirah Lakes Towers (JLT) in Dubai. No injuries were reported.

Shortly after the publication of this article, the CTIF Centre for Fire Statistics (CFS) received the first international inquiries about whether international statistics on high-rise fires exist. At that time, the CFS unfortunately always had to give negative answers. However, we kept receiving other similar requests - most questions regarding the high-rise fires related to the consequences of the **9/11 events in New York City**.

After the major fire on June 14, 2017, in North Kensington, London (UK), the CFS again received increasing inquiries on high-rise fires. **Grenfell Tower Fire**: On the night of June 13 14, 2017, the social housing property, which was completed in 1974 and modernized in 2015-2016, burned down to a large extent. The fire spread over the newly thermally insulated, rear-ventilated façade within a few minutes. 72 people

[1] https://www.zawya.com/en/business/towers-on-fire-in-the-uae-2010-2012-oy82ok9q.

were killed. From then on, international interest in high-rise fires in general and the problem of façade fires on high-rise buildings steadily increased.

In connection with this tragic fire, questions were also asked regarding the fire brigade's firefighting tactics and the evacuation scheme for the high-rise residents.

Statement of Center for Fire Statistics of CTIF:

- In principle, compromises regarding safety made vis-à-vis architects, planners, owners, and operators of high-rise buildings must not be transferred to the local fire brigades.
- If a city administration legitimizes the construction of high-rise buildings, the local fire department must be adequately equipped, and the building owner must bear the corresponding costs.
- Local administrations are well aware of the fire service's operational capabilities, which are limited: turntable ladders are only available with an operational height of 64 m.
- Super-special vehicles for rescuing people, such as hydraulic lifting platforms, reach the currently technically feasible maximum of 100 meters.
- Practice shows that in the event of a high-rise fire, a high-rise-trained fire brigade needs around 1 minute per floor to bring help to a burning building with 20 or more floors.
- The hope of the building owners, opera, and the city administration that all preventive measures will be effective in the event of a fire is more than clouded by reality. High casualty figures among both civilians and firefighters speaks a different language.
- Preventive measures must be effective with 95% certainty. Thus, only 5% may be transferred to the fire brigades as a residual risk.
- Fires on the building façade are a new challenge. Architects, planners, and the administration must realize that they must replace combustible materials with non-combustible materials without any alternative.
- Every administration must ensure that reliable statistics on high-rise fires are maintained. That is the only way to enable an international exchange of experience.

Since then, the CFS CTIF has begun to collect and evaluate data on high-rise buildings. Later, the CFS CTIF addressed "**Fire Causes**" in Report 28 and Report 29, followed by a special chapter on "**About Forest Fires**." For the current Report 30, we have decided on the topic of "**Towers on Fire - High-rise buildings”**

We would like to take this opportunity to thank all our colleagues from the fire departments, the students, and researchers who sent us a variety of references to sources and specialist articles.

Our efforts to shed some light on the topic and gather facts and figures are certainly limited. For this reason, we look forward to any criticism, hints, and other advice on how to better address this complex topic in the future. Only expanded international cooperation can help.

The present special chapter is therefore devoted to the question of high-rise buildings, the potential dangers of this type of building, and the fires that have become known. For objective reasons, there can be no claim to completeness and conclusive evaluation of the situations described. Instead, the present evaluation is intended to encourage all readers to examine the local/national statistics on high-rise fires and share further results of a statistical nature with the CFS CTIF.

This chapter is divided into the following sections.

Section 1 looks at the **historical aspects** of the development of high-rise buildings, followed by a **literature review** in **Section 2**. Around **50 international publications** from the period from **1986 to 2024** were considered.

In **Section 3**, **113 case studies** about international high-rise fires are selected.

Section 4 reflects the high-rise buildings used in **36 selected cities.**

Hospitals in high-rise buildings considered in **Section 5**.

Section 6 looks at **hotels** housed in high-rise buildings.

The fact that high-rise buildings are fascinating as **residential properties** is illustrated in **Section 7**.

Section 8 reflects on the **fires in high-rise buildings** that have become known.

The specific issue of **façade fires in high-rise buildings** is considered in **Section 9**.

Special case study is illustrated **in Section 10**: Berlin (Germany).

Section 11 presents the results of a CFS CTIF **survey on high-rise buildings** in all CTIF member states.

1.0 History of High-rise Buildings

Important data sources regarding high-rise buildings are as follows:

- **Emporis** was a building database for the international real estate industry available from 2000 to 2022. In 2000, the website was founded under the name Skyscrapers.com to collect information on skyscrapers and high-rise buildings. In 2003, the database was expanded to cover all types of buildings. In November 2020, Emporis was acquired by CoStar Group (USA). The **Emporis** website, **www.emporis.de**, has been shut down.
- The **Council on Tall Buildings and Urban Habitat (CTBUH), https://www.ctbuh.org/,** is the world's leading nonprofit organization for all interested in cities' future. It explores how increased urban density and vertical growth can support more sustainable and healthy cities, especially in the face of mass urbanization and the increasing effects of climate change worldwide. The relationship between policy, buildings, people, urban density, urban space, interior space, and infrastructure is key.

In the entire present article, we refer to both sources for the most part or show other sources used. The history of the high-rise building is described in a short form. [2] [3] [4]

By the 19th century, people had reached tall buildings according to their respective technical possibilities; until then, all for reasons of religion. The **Pyramids of Egypt** were constructed around 2500 BC as tombs for Pharaohs and stood about 140 m tall. These ancient tall structures were not used as human habitats but were monuments and places of worship. In the Middle Ages, between the 11th and 13th centuries, **tall towers were used in San Gimignano**, Italy, for defense but were later used as residential buildings. Even though most of the structures have collapsed, some have been preserved on the city's skylines, with the tallest towers exceeding a height of about 50 m.

Until the mid-19th century, **gothic cathedrals** were some of the tallest facilities in the world. In Europe, the construction of cathedrals established a quasi-religious status for the masons designing these amazing structures. For instance, the Cologne Cathedral was begun in 1248, and the masons used their knowledge to build a structure that must have installed awe in all who looked upon her. About 80 churches have church towers with a height of 100 meters and more. Here we list the most important examples:

- The tallest church building in the world is the Ulm Minster (161,5 m), the main Lutheran congregation in Ulm, Germany.
- The tallest Catholic and domed church building is the Basilica of Our Lady of Peace (158 m) in Yamoussoukro, Ivory Coast.

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[2] Ubani Obinna et al. (2021) The historical development of tall buildings: Highrise buildings, https://structville.com/2021/02/the-historical-development-of-tall-buildings-high-rise-buildings.html.
[3] A.A. Tarantsev, R.N. Novoselov, and A.Y. Rodichev: Highrise Buildings Increased Their Fire Danger, Saint-Petersburg University of State Fire Service of EMERCOM of Russia.
[4] https://theconversation.com/a-short-history-of-tall-buildings-the-making-of-the-modern-skyscraper-56850, A short history of tall buildings: the making of the modern skyscraper, published: May 10, 2016.

- The tallest church building with two steeples and the tallest cathedral is Cologne Cathedral (157.4 m) in Cologne, Germany.
- The tallest Eastern Orthodox and domed cathedral will be the People's Salvation Cathedral (now 120 m; 127 m when completed) in Bucharest, Romania.
- St Martin's Church (130.6 m) is the tallest brickwork church building in Landshut, Germany.
- St Mary's Church (125 m) is the tallest brickwork church building in Lübeck, Germany, with two steeples.
- The tallest wooden church building is Săpânța-Peri Monastery church (78 m) in Săpânța, Romania.
- The tallest church building in the Americas is the Cathedral of Maringá (124 m) in Maringá, Brazil.
- If completed, the Sagrada Família in Barcelona, Spain, will be the tallest church building in the world, at 172.5 m.

Due to the limitations associated with building tall buildings using materials such as timber and bricks, builders began to look for alternative materials. The Industrial Revolution provided these materials, such as wrought iron and steel. This also provided the social impetus for building tall buildings, as more workers from the countryside were required to work in the factories, so houses had to be provided for them.

At the end of the 19th and beginning of the 20th century, the **prerequisites for multi-story construction** were outlined as a result of economic growth in the USA. Some technical inventions were very helpful in implementing ideas for the construction of multi-story buildings with great height.

One of the technical prerequisites for creating multi-story buildings was the **invention of the steam elevator** by the engineer Elisha Graves Otis (1811-1861). With its help, lifting people and cargo to a considerable height was possible. The elevator was insured: in the event of a rope breakage, an emergency spring mechanism was activated, which blocked the passenger compartment and stopped the fall. As early as 1857, the elevator was installed in one of the administrative buildings in New York.

With the **invention of the carbon microphone** around 1878, independently of each other by Thomas Alva Edison, Emil Berliner, and David Edward Hughes, in conjunction with the improvement of the handset by Werner von Siemens, the prerequisites for communication over longer distances became possible without the opponents facing each other directly. An intermediary (primarily women) initially used the so-called manual switching to establish telephone connections. That provided the technical possibility of communicating within a large and tall building.

The **invention of the electric motor** led to the fact that around 1837/1838, the basis for an electric motor drive was known and could also be developed into an application-ready working machine. Werner von Siemens patented his dynamo machine in 1866. For the first time, it made generating electrical energy on a larger scale possible. That helped the electric motor to achieve a breakthrough for a practical, widespread application.

Imperfect construction technologies have been an obstacle to the construction of high-rise buildings. The main weight of the building was absorbed by the load-bearing walls, which had to be made quite thick for tall buildings. Frame construction, the basic principles of which were developed in the 70s-80s of the 19th century, helped solve this problem. The main load of the building fell on the steel frame, and the strength of the walls was no longer so important.

After the World's Fair success, the mechanic gradually developed the elevator in his Otis Elevator Company, which was founded in 1853. On March 23, 1857, the world's first passenger elevator with fall protection was operated in New York's Haughwout department store. A steam engine powers Otis' elevator and still travels at a leisurely 0.2 meters per second. The following year, the first hydraulic elevator in a building on Broadway began operation. Here, for the first time, a more modern fall device is used, which triggers delayed braking so that passengers do not come to a stop quite as abruptly in the event of a cable break. In 1880, Werner von Siemens presented the first electric elevator in Mannheim. In 1887, the inventor Alexander Miles developed a mechanism for automatically closing elevator doors and applied for a patent in the same year.

Due to the further development of the gearboxes, elevators are becoming faster and faster, allowing construction to ever greater heights in conjunction with the steel skeleton construction.

Another prerequisite for constructing high-rise buildings is the **invention of reinforced concrete**. In the middle of the 19th century, concrete components were reinforced with iron inserts for the first time in France. In the USA, the first high-rise building was built in 1902 with the 16-story Ingalls Building in Cincinnati, and in 1903–1904, the first factory building in reinforced concrete was built with the Packard automobile plant.

The American technological revolution of 1880 to 1890 saw a burst of creativity that produced a wave of new inventions that helped architects to build higher than ever before: **Bessemer steel**, formed into I-sections in the new rolling mills, enabled taller and more flexible frame design than the cast iron of the previous era; the newly-patented sprinkler head allowed buildings to escape the strict, 23-meter height limit, which was imposed to control the risk of fire; and the patenting of AC electricity allowed elevators to be electrically powered and rise to ten or more stories.

While land prices are exploding on the ground in the increasingly crowded metropolises, the sky above the cities is open indefinitely. With the discovery of the vertical, the social structure of the buildings has also been turned upside down. Whereas the first floor for the city nobility and bourgeoisie was previously located just above the street on the first floor, the rich and powerful are now drawn to the very top. Thanks to the elevator, you no longer have to pay for a panoramic view of the city with laborious stairs. The attics where the servants previously lived will become the exclusive penthouse in the skyscraper. The world's highest is currently at the top of the 426-meter-high apartment tower 432 Park Avenue in Manhattan. In 2016, it was acquired by a billionaire from Saudi Arabia for $88 million.

The global race for the tallest building also leads to the **construction of longer and faster elevators**. Since the end of the 1960s, the tallest elevator in Europe has been taking visitors to the observation deck at 337 meters in Moscow's Ostankino TV Tower. The highest open-air lift on the European continent has been on the road in the Swiss mountains near Lucerne for 115 years. Since 1905, the Hammetschwand lift has been transporting passengers 118 meters to the viewpoint of the same name above Lake Lucerne. The wooden cabin, which is covered with zinc sheeting, once took about three minutes to do this. With the glazed panorama cabin installed in 1992, one can reach the top in about a minute.

The impetus for developing and implementing the latest construction technologies was the fire of 1871, in which most of the buildings of Chicago, the largest industrial center in America, were utterly destroyed.

For this reason, Chicago was destined to become the birthplace of skyscrapers. It was here that the Nome Insurance Building was built in 1885 according to the design of the architect William Le Baron Jenney, which existed until 1931. Among the other buildings, it stood out for its height and the special construction technologies used. It was the first house to be built in a frame. The number of high-rise buildings began to rise rapidly. Russia and the European powers were skeptical of skyscrapers and remained true to their traditions. In America, however, the new type of construction quickly gained popularity.

Chicago did not remain the capital of skyscrapers for long. From 1890, when the 16-story World Building office was built with a height of 94 meters, until 1972, New York took over the baton of high-rise cons high-rise and held it firmly in its hand. It was the country's leading financial center, and most of the new high-rise buildings were on behalf of large firms and businesses. It is not difficult to understand why representatives of the American economy fell so much in love with skyscrapers: their height symbolized the owner's wealth, power, and prosperity. 1894, the Manhattan Life Insurance Company erected a 20-story Manhattan Life Insurance Building (106 m). The next step was the 30-storey Park Row Building (119 m, architect R.H. Robertson), the tallest building in the world for nine years. The Singer building, built in 1908 (187 m), broke his record. This result lasted only one year, and as early as 1909, the Metropolitan Life Tower was built, the height of which was 213 m. For a long time, the palm tree was held in place by the 241-meter-high skyscraper by architect Gus Gilbert, which was built on behalf of the multimillionaire Frank Woolworth and named after him (Woolworth Building). It was not until 1930 that the building, which was called "Chrysler," broke the record set up to that point. The skyscraper's architect, William Van Allen, had to use a few tricks to achieve this goal. At the same time as his creation, the office of the Bank of Manhattan was built nearby, whose creators also wanted to set a height record. Therefore, the Chrysler building project, especially its height, had to be kept under the strictest secrecy for a long time. Ultimately, this helped Van Allen outperform the competition, but not for long. The height of the building he erected of 319 meters remained insurmountable for only a few months. As early as 1931, the famous New York skyscraper Empire State Building was constructed. The 102 floors of this building have risen to a height of 391 meters above New York. In the early 50s, a television antenna was installed on the skyscraper's roof. Thanks to her, the building has grown a little more and remained the tallest in the world until the 70s.

After WWII, skyscrapers began to take on modern forms, increasingly resembling giant cubes and cuboids. At the same time, skyscrapers ceased to be exclusively multi-story buildings. Shopping malls, cinemas, restaurants, hotels, and other infrastructure facilities appeared in them.

In the 70s, there was intensive construction of high-rise buildings worldwide. In New York, the infamous Twin Towers are currently being built. They were the first office buildings to exceed the threshold of 400 meters. However, this altitude record proved to be short-lived. As early as 1973, the 443-meter-high Sears Tower skyscraper was built in Chicago. This 110-story building was an engineering marvel at the time of its completion. It had 15 high-speed elevators that transported people to a height of almost half a kilometer in seconds. In the second half of the twentieth century, skyscrapers gradually conquered the world. In many ways, the war was the impetus for such rapid development, which destroyed dozens of cities. Some settlements had to be rebuilt, as most pre-war structures could not be restored. High-rise buildings have been erected very actively in Germany. Frankfurt am Main, the country's financial capital, is often compared to New York or Chicago due to the large number of skyscrapers. In the Soviet Union, the construction of high-rise buildings received positive results.

With the beginning of economic growth in Southeast Asian countries, the boom in the construction of skyscrapers shifted to this region. In recent decades, hundreds of high-rise buildings have been built there. They are the ones who decisively determine the appearance of the region's most important megacities. That is where the primary battle for the title of the world's tallest building unfolds today. Until recently, the palm was held in place by the 453-meter-high Malaysian twin towers from Kuala Lumpur (Malaysia), built in 1998, but in 2003, a skyscraper was ceremoniously opened in Taipei (Taiwan) after crossing the half-kilometer line. On the 101st floor of the 508-meter-high giant, there are numerous offices, shopping centers, and even an observatory.

Currently, the tallest buildings in the world can be listed as follows:

1. Burj Khalifa, Dubai, 828 m,
2. Merdeka 118, Kuala Lumpur (679 m), Shanghai Tower, China (632 m),
3. Makkah Royal Clock Tower, Mecca (601 m), Ping An Finance Center, Shenzhen (599 m),
4. Lotte World Tower, Seoul (555 m), One World Trade Center, New York City (541 m),
5. Guangzhou CTF Finance Center, China (530 m), Tianjin CTF Finance Center, China (530 m),
6. Sitik Tower, Peking (528 m), and Taipei 101, Taiwan (508 m).

Further developments remain to be seen.

Resumé:

1. The reasons given for building high-rises are usually the lack of space, the desire to concentrate services in one place, and a wide range of advantages for the users or residents of the buildings.

2. The development of new building materials and the technologies they made possible spurred the construction of high-rise buildings. Various technical inventions supported this process.

3. Safety issues were only discussed after fires and other accidents in these buildings were recorded.

2.0 Literature Review

There is a constantly growing number of international specialist literature on high-rise buildings, tall buildings, or skyscrapers. In the following, we will briefly present some of the most interesting publications from 1986 to 2024. The overview is not subject to completeness but is intended to encourage students to delve deeper into the current issues with their questions to draw conclusions for their own work and to receive suggestions. At the end of this section, we would like to add a few remarks from the point of view of the Centre for Statistics at CTIF.

In a technical article from 1986, the authors deal with the question of the **movement of people on stairs during a fire evacuation exercise in a high-rise building**. In doing so, they elaborate on the following. Behavior of people during a simulated- fire evacuation practice in a high-rise office building in Tokyo was observed through video recording: subjective evaluation by the evacuees was also collected. About a fifth of the residents present in the building evacuated through two emergency stairs to the ground. The result suggests that flow stagnation within the stairwell was noted in several spots, even with this small number of evacuees. It was pointed out that doors opening into the stairway obstructed the smooth flow of people in the stairwell. Simultaneous total evacuation seems impractical in high-rise buildings; reasonable procedures for selective evacuation need to be developed. It is also concluded that more frequent education on fire safety is necessary for the building users to get accustomed to evacuation procedures and facilities. [5]

In the event of a fire, it is of particular importance in a high-rise building whether or not doors can stop the fire smoke. In addition, a **comprehensive test of the smoke escaping from the doors of a high-rise apartment** is reported. A check of smoke leakage of an entrance door, class A fire door, for high rise apartment was carried out in a full-scale model using a model fire source designed to smolder for 1 hour and then flame. The door openable inward and outward with and without air-tight material were used. A total 13 types of experimental conditions were carried out with major variables of door situation (open or close) and pressure difference between fire room and corridor. Concentrations of smoke, gas, and smoke particles, as well as pressure, temperatures, and weight of the fire source, were measured. There was no difference in smoke leakage performance between doors openable inward and outward. Smoke and combustion gas in the corridor were hardly observed when the entrance door was closed. Therefore, it suggests that the middle corridor was safe enough for evacuation when the door was locked. [6]

In a Spanish article from 1987, **firefighting in high-rise buildings** is examined from the point of view of a **building inspection institute**. From the point of view of fire protection, the high-rise buildings have a special consideration, according to the design activities carried out and the fire protection system installed in them. In high rise buildings, difficulty of access by extinction services should be taken into account, as

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[5] Kagawa, M., Kose, S. and Morishita, Y., 1986. Movement Of People On Stairs During A Fire Evacuation Drill-Japanese Experience In A High-rise Office Building. Fire Safety Science 1: 533-540, doi:10.3801/IAFSS.FSS.1-533.
[6] Sugawa, O., Ogahara, I., Ozaki, K., Sato, H. and Hasegawa, I., 1986. Full-Scale Test Of Smoke Leakage From Doors Of A High-rise Apartment. Fire Safety Science 1: 891-900. doi:10.3801/IAFSS.FSS.1-891.

well as the impossibility of proceeding to make total evacuation. Consequently, it is necessary to design the building with both vertical and horizontal exteriorization criteria and protect the structural elements, which will make it possible to suffocate the fire and the partial evacuation of the occupants to independent neighboring sectors. [7]

A study from 1991 describes numerical **simulations of high-rise building fires extending to upward floors via windows**. Flames and hot gases ejected from openings and flowing along vertical building exterior walls may fracture window glasses and accelerate the fire growth toward upper floors. Particularly, there have been no numerical studies of dynamic fire behavior around windows and along vertical exterior walls about fire growth. Here are attempted numerical finite-difference studies of the time-dependent flow behavior of fires along external building walls and the behavior of fires invading the upper-floor windows. Two-dimensional numerical simulations show that upward flows adhere closely to the wall surface, similar to the experimental flow patterns. Some large-scale vortices are created around the upward fire gases. Almost periodically, "hot" gases enter the room immediately above the fire room via windows. The regular oscillatory motion depends upon the heat release rate in the fire room and is weakly affected by the window configurations. [8]

A publication from the USA (1997) discusses the time delay for starting the evacuation from buildings based on various case studies. Models to predict occupant response and evacuation will be an essential part of the move throughout the world toward performance-based codes and standards, as they are necessary for calculating the time required for occupants to reach safety, given a proposed design. To obtain realistic evacuation time predictions, it is essential to accurately calculate the delay times occupants take before beginning evacuation. The paper reviews the findings from five evacuation studies. These studies include emergency evacuation drills in high-rise and high-rise office buildings. Findings from two fire incidents - a six-fatality high-rise apartment building fire in Canada and the World Trade Center bombing in New York City - are also discussed. The findings of particular interest are those related to problems in alerting occupants, delays reported or observed during evacuations, and the reasons behind those delays. [9]

From the USA comes an article from 1997 that deals with people's behavior during the evacuation of buildings. An **explosion below the World Trade Center Plaza in New York City** on February 26, 1993, killed six workers and resulted in injuries to over 1,000 occupants as they made their way out of the affected buildings. The explosion and subsequent fire caused extensive structural damage on several basement levels, interfered with the operation of the fire protection and other emergency systems, and resulted in the evacuation of tens of thousands of occupants of the complex. The National Fire Protection Association (NFPA) and the National Research Council of Canada (NRC) undertook a research project funded by the

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[7] F. Núñez Astray, G. Campos Martínez, J. A. Labrador San Ronnualdo y M. Sanz Septién: INCENDIOS EN EDIFICIOS DE GRAN ALTURA (THE FIRE IN HIGH RISE BUILDINGS), INSTITUTO TECNOLÓGICO DE SEGURIDAD, MAPFRE, ITSEMAP, CENTROTECNOLÓGICO DEL FUEGO, Informes de la Construcción, Vol. 39 n. 391, septiembre/octubre, 1987.

[8] Satoh, K. and Kuwahara, K., 1991. A Numerical Study Of Window-to-Window Propagation In High-rise Building Fires. Fire Safety Science 3: 355-364. doi:10.3801/IAFSS.FSS.3-355.

[9] Proulx, G. and Fahy, R.F., 1997. The Time Delay To Start Evacuation: Review Of Five Case Studies. Fire Safety Science 5: 783-794. doi:10.3801/IAFSS.FSS.5-783.

National Institute of Standards and Technology, the General Services Administration, NFPA, and NRC to study the behavior of building occupants in this incident and to document, to the extent possible, those engineering details such as building design, fire safety features, training, and smoke spread, that affected behavior. Over 400 occupants of the two 110-story office towers responded to a survey sent to the approximately 1,600 employees and tenants who were members of the fire safety team. The paper summarizes their responses, compares the responses between the two towers, and summarizes data on response times and initial actions. [10]

In 2000, a study from Japan dealt with the question of the **evacuation of people by elevators**. At a building fire, occupants should usually escape to the ground level or a floor of refuge by stairs, but not by elevators. However, in many of the past fires, not a few people used elevators for their evacuation. Also, the number of people who have difficulty using stairs in an evacuation is expected to increase since the proportion of aged people in the total population has been rapidly increasing recently in Japan. To consider this situation, we made a simplified elevator service model to evaluate the effectiveness of elevator evacuation. We conducted some case studies to examine the feasibility and problems of elevator use for evacuation. As a result of case studies, the diverging point of the advantage of evacuation by elevator compared with evacuation by stairs appears roughly on the 14th floor to the 16th floor. [11]

In 2002, an article by the U.S. Fire Administration described the **situation regarding high-rise fires in the USA**:

- An estimated 15,500 high-rise structure fires caused 60 civilian deaths, 930 injuries, and $252 million in property loss each year.
- High-rise fires are more injurious and cause more damage than all structure fires.
- Three-quarters of high-rise fires are in residential structures, but these cause only 25% of dollar loss.
- Cooking is the leading cause of all high-rise fires (38%), but cause patterns vary by property type.
- 69% of high-rise structure fires originate on the 4th floor or below, 60% in apartment buildings, and 43% in the kitchen.
- High-rise fires are inherently more difficult for the fire service. [12]

An **analysis of high-rise fires and people's awareness of fire protection through fire statistics and field investigations** will be carried out in 2003 using the example of the Brazilian city of Sao Paulo. As one of the main megacities in developing countries, Sao Paulo is characterized by serious urban problems in undeveloped countries and some amenities from developed ones. One of the consequences of this situation is the unique fire safety problems found in large-scale buildings such as shopping malls, multiple-use complexes, and high-rise buildings, where the lack of adequate fire regulation can drive the construction of modern but unsafe spaces. The paper presents the results of a study of high-rise building

[10] Fahy, R.F. and Proulx, G., 1997. Human Behavior In The World Trade Center Evacuation. Fire Safety Science 5: 713-724. doi:10.3801/IAFSS.FSS.5-713.
[11] Sekizawa, A., Nakahama, S., Ikehata, Y., Ebihara, M. and Notake, H., 2000. Study On Feasibility Of Evacuation By Elevators In A High- Rise Building -A Case Study For The Evacuation In The Hiroshima Motornachi High-rise Apartments-. AOFST 4.
[12] U.S. Fire Administration: High-rise Fires, TOPICAL FIRE RESEARCH SERIES, Volume 2, Issue 18, January 2002.

fires through the analysis of the Sao Paulo State Fire Department database and a field survey in high-rise office buildings, focusing on the occupant's fire safety consciousness. Despite the concern of some public authorities about fire safety improvement, it is very clear that the general population, particularly those who live or work in high-rise buildings, is neither aware of fire prevention measures nor prepared to face fire incidents. These matters are also discussed and analyzed in the paper. [13]

In a paper from 2003, the authors deal with **mitigating the effects of wind influences on the performance of pressurization systems in high-rise buildings**. Stairwell pressurization systems should ensure a sufficiently high velocity at open doors between the stairwell and the fire floor without exerting large forces on closed doors in the stairwell. Strong winds may make it difficult, and often impossible, to simultaneously fulfill these two requirements in tall buildings. A simple model is used for evaluating the possible use of different design parameters, such as the shape and size of the stairwell, the flow resistance of the exit path, the orientation of the exit door relative to the direction of prevailing strong winds, additional lobbies, pressurization of the elevator shaft, and the type and location of the injection system, for mitigating the effect of winds on the performance of pressurization systems. Several examples are presented and compared. One novel finding is that a helical stairwell configuration with a relatively low flow resistance may drastically reduce adverse wind effects. Results of a 1:10 scale model study of flow in a helical stairwell are presented, which show that its resistance to flow resistance is approximately one-quarter of that of convectional-type stairwells. [14]

Aspects of **fire safety provisions in ultra-high-rise buildings** are discussed in the paper by an expert from Hong Kong. The total fire safety concept of implementing software fire safety management to control hardware provisions in passive building construction and active fire protection systems is recommended. Key points on fire safety in these buildings are pointed out for further research. These include fire spread over buildings, crowd movement and control, preventive measures such as applying appropriate fire protective coatings to give a more extended fire resistance period, and a feasibility study on using new fire protection systems. A risk management scheme should be worked out scientifically. Education and training of fire engineers are essential. The possibility of inducing an urban mass fire is also pointed out. [15]

A refined **concept of emergency total evacuation by lifts** was proposed in 2005. The proposed strategy combines stair evacuation from a group of occupied floors to a refuge floor, followed by lift evacuation from the refuge floor to the street level. The lift shaft pressurization or water entry protection provisions in the lift shaft can be eliminated since shuttle lifts with blind shafts without any openings on typical floors are used as the evacuation lift. The possible risk of fire and smoke affecting the occupants waiting in the lift lobbies can be entirely solved since the lift pick-up floors are located on the refuge floor levels, which are designed to be a temporary place of safety for occupants' refuge. This refined emergency lift evacuation strategy has been studied in a proposed super-high-rise building. The traditional total building

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[13] Ono, R., 2003. An Analysis Of High-rise Building Fires And Human Fire Safety Consciousness Through Fire Statistics And Field Survey. Fire Safety Science 7: 1073-1084. doi:10.3801/IAFSS.FSS.7-1073.

[14] Poreh, M., Trebukov, S. and Gurevitz, T., 2003. Mitigation Of Wind Effects On The Performance Of Pressurization Systems In High-rise Buildings. Fire Safety Science 7: 753-762. doi:10.3801/IAFSS.FSS.7-753.

[15] W.K. Chow: Aspects of fire safety in ultra-high-rise buildings, Department of Building Services Engineering, The Hong Kong Polytechnic University, Hong Kong, China; International Journal on Engineering Performance-Based Fire Codes, Volume 6, Number 2, p.47-52, 2004.

evacuation using stairs and the proposed alternative evacuation strategy have been simulated using the 3-D evacuation software STEPS to demonstrate evacuation efficiency. The results show that the total building evacuation time can be shortened significantly by adopting the refined concept, and such concept can be put into practical usage without significant violation to existing conventional stair evacuation strategy and additional investment in evacuation safety provisions. [16]

Another article from 2008 describes the **fire risk of high-rise buildings based on human behavior** during fires. The paper describes the fire risk of high-rise buildings related to evacuation in case of fire. The fire risk is based on human behavior and the determinants of a safe evacuation of occupants during a fire. An extensive review of literature on human behavior in fires revealed the determinants for fire safety engineering about the survival of occupants. In the paper, the determinants are set out to assess fire risk in particular high-rise buildings. [17]

The following article from the USA (2010) outlines the **fire situation regarding high-rise buildings**. In 2005-2009, an estimated 15,700 reported high-rise structure fires per year resulted in associated losses of 53 civilian deaths, 546 civilian injuries, and $235 million in direct property damage per year. An estimated 2.6% of all 2005-2009 reported structure fires were in high-rise buildings. [18]

An article from China analyzes **the factors of high-rise fires, their causes, and corresponding fire protection measures**. High-rise building fires have many characteristics, such as the diversity of blazing factors, various ways of spreading fires, the difficulty of evacuation and saving activities, etc. Thus, to attain a partial event tree whose top event is the direct fire hazard loss, a comprehensive analysis of the factors that can cause high-rise building fires is needed. Establishing a high-rise building fire safety system and countermeasure begins with "man-machine-environment," that is to say, technology (hardware) and management (software), which highlight the effect of guiding and coordination of management to technology, with management as outlines and technology as a method: establishing and improving the save system, strengthening "Three Simultaneous," enhancing safety management of the related personnel and cultivating the sense of safety, sounding the fire precautionary emergency program. The study aims to solve the fire protection problem of high-rise buildings and provide some practical value to designing high-rise buildings, assessing fire safety, and establishing precautionary emergency programs. [19]

An article from Vietnam (2012), divided into three sections, underlines the **problem of fire risks in high-rise buildings** in Southeast Asian countries. The first part presents recent fire incidents and causes. The

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[16] Wong, K.H.L., Hui, M.C., Guo, D.G. and Luo, M.C., 2005. A Refined Concept On Emergency Evacuation By Lifts. Fire Safety Science 8: 599-610. doi:10.3801/IAFSS.FSS.8-599.
[17] Kobes, M., J.Post, I. Helsloot, B. de Vries (2008): Fire risk of high-rise buildings based on human behavior in fires. In: Conference Proceedings FSHB 2008. First International Conference on Fire Safety of High-rise Buildings. Bucharest, Romania, May 07-09,2008.
[18] NFPA: High-rise Building Fires. U.S. Department of Housing and Urban Development, https://www.hud.gov/.
[19] LIU Xiuyu, ZHANG Hao, ZHU Qingming: Factor analysis of high-rise building fires reasons and fire protection measures, School of Civil Engineering and Architecture, Anhui University of Technology, Ma'anshan 243032, Anhui, China, Procedia Engineering 45 (2012) 643 – 648, 1877-7058 © 2012 Published by Elsevier Ltd., doi: 10.1016/j.proeng.2012.08.216, 2012 International Symposium on Safety Science and Technology.

second analyzes scientific bases for minimizing fire risk in high-rise buildings in Vietnam. The last part suggests a future direction for improving the situation. [20]

In 2013, the NFPA published a report on the **high-rise fire situation in the USA**. In 2007-2011, there were an average of 15,400 reported structure fires in high-rise buildings per year and associated losses of 46 civilian deaths, 530 civilian injuries, and $219 million in direct property damage per year. Four property classes account for half of high-rise fires: apartment buildings, hotels, office buildings, and facilities that care for the sick. Automatic fire protection equipment and fire-resistive construction are more common in high-rise buildings that have fires than in other buildings of the same property use that have fires. The risks of fire, fire death, and direct property damage due to fire tend to be lower in high-rise buildings than in shorter buildings of the same property use. [21]

An article from Great Britain (2013) discusses the **effects of vertical fires on the collapse of tall buildings**. Many previous tall building fires demonstrate that despite code-compliant construction, fires often spread vertically and burn over multiple floors simultaneously. The collapses of the WTC complex buildings on 9/11 and other partial collapses like the ones of the Windsor Tower in Madrid and the Technical University of Delft building posed new questions on the stability of tall buildings in fire. These accidents have shown that local or global collapse is possible in multi-floor fires. In most of the previous work involving multi-floor fires, all floors were assumed to be heated simultaneously, although, in reality, fires travel from one floor to another. The paper extends prior research by focusing on the collapse mechanisms of tall buildings in fire and performs a parametric study using various traveling rates. The results of the survey demonstrate that vertically traveling fires have a beneficial impact on the global structural response of tall buildings compared to simultaneous fires. Contrary to the beneficial effect of the travelling fires in terms of the global structural response, it was noticed that higher tensile forces were also present in the floors compared to simultaneous multi-floor case. Designers are therefore advised to consider simultaneous multi-floor fire as an upper-bound scenario. However, a scenario where a traveling fire is also suggested to be examined, as the tensile capacity of connections may be underestimated. [22]

In 2014, a technical article reported on an **experimental study on the properties of the temperature field of the fire chamber under chimney effect in a scaled high-rise model**. A set of experiments was conducted in a scaled building model with 12 floors to study the temperatures of the fire room under stack effect in a high-rise building. The fuel mass loss rate, radiant flux, heat flux and temperatures in the atria and fire room at the first floor were experimentally investigated. The flames of pool fires in the room are tilted towards the staircase under the airflow induced by the stack effect. The mass loss rate of fuel is influenced slightly by the position of the window opened on the stairs. At the same time, the temperature distribution in the atria and fire rooms is different in the opened and closed staircases. The hot smoke temperatures

[20] Doan Minh Khoi and Pham Thuy Loan: Fire Safety in High-rise Buildings in Vietnam, Urban and Architectural Institute, National University of Civil Engineering, Vietnam, Fire Science and Technology Vol.31 No.3 (Special Issue) (2012) 139-146.

[21] John R. Hall, Jr.: High-rise Building Fires, NFPA, September 2013.

[22] Panagiotis Kotsovinos, Yaqiang Jiang, and Asif Usmani (Edinburgh, United Kingdom): Effect of Vertically Travelling Fires on the Collapse of Tall Buildings, The International Journal of High-rise Buildings (IJHRB), Vol.2 - No.1, Date: Mar., 2013.

in the atria and fire room on the first-floor increase with an increasing pool size. The upper hot smoke temperatures in the atria are higher than those in the fire room in cases with an opened staircase. Compared different positions of the window opened in the staircase, it can be found that the upper hot smoke temperatures in the atria in cases with the 3rd floor window opened are the highest due to the weaker stack effect. In the closed staircases, the upper hot smoke temperatures in the fire room are much higher than those in the atria on the first floor. Besides, the radiant and heat flux of the left sidewalls of the staircase in an opened staircase are higher than those in a closed staircase due to the tilted flame. The results obtained in the paper may be used for the safety design of the room in high-rise buildings. [23]

Building and **façade fires** are considered from the point of view of physics and possible applications. As several historical and recent incidents have shown, façade fires being a disastrous hazard for high rise building has attracted the interests of numerous fire scientists, engineers and regulators. This work aims to present issues in this area that are challenging and need further attention. It focuses on characterizing the flame height and heat fluxes from façade flames produced from under-ventilated enclosure fires on a façade that is not flammable. Such an investigation is an essential consideration for practical applications and a prerequisite for examining fire spread on flammable façades and designing a test for modern façade assemblies. The mass pyrolysis rates and burning of real fuels are discussed in under-ventilated rectangular or corridor-like enclosures for various openings, presenting the current state and some critical issues. Façade flames are analyzed from experiments using gaseous burners to control the fuel supply rate by introducing physical length scales for the opening geometries to model flame heights and heat fluxes. An essential parameter for the façade flames is the excess heat release rate of the fuel burning outside the enclosure. Finally, applications for façade flames with sidewalls and façade flames from two openings are presented. [24]

A report from Japan reports on a super project: **TORANOMON HILLS**, the main building of a **large-scale re-development project** located in the center of Tokyo. This high-rise building has a height of 247 m and 52 floors above ground, five floors below ground, and 62 m * 80 m in plan. It is used as a hotel, residential facilities, offices, shops, and conference facilities. The superstructure is a rigid steel frame with response-control devices using concrete-filled steel tube columns. The underground section is a mixed structure of steel, steel-reinforced concrete, and reinforced concrete framings. The piled-raft foundation type is used. The remarkable feature of this high-rise building is that the motorway runs through its basements, making it stand just above the motorway. This condition is an essential factor in the building design. The plan shape is designed to fit along the curve of the motorway. Special columns at the corners are required to avoid placing columns on the highway. This special column is a single inclined column on the lower floors that branches into two columns on the mid-floors to suit the column location on the upper floors. The cast steel joint is used as each special column's branching point to transfer the stress securely. [25]

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[23] Shi W., Ji, Jie, Sun, J., Lo, S.M., Li, Linjie and Yuan X., 2014. Experimental Study on the Characteristics of Temperature Field of Fire Room under Stack Effect in a Scaled High-rise Building Model. Fire Safety Science 11: 419-431. 10.3801/IAFSS.FSS.11-419.

[24] Delichatsios, M.A., 2014. Enclosure and Façade Fires: Physics and Applications. Fire Safety Science 11: 3-27. 10.3801/IAFSS.FSS.11-3.

[25] Yasuyoshi Hitomi, Hiroshi Takahashi, and Hidenori Karasaki (Tokyo, Japan): TORANOMON HILLS - Super High-rise Building on Urban Highway, The International Journal of High-rise Buildings (IJHRB), Vol.3 - No.3, Date: Sep., 2014.

Fire incidents in Dubai, United Arab Emirates, reported to the Forensic and Mechanical Engineering section of the Dubai Police Forensic Laboratory during 2006–2013 were reviewed. A detailed examination of more than 5000 incidents, representing a wide range of fire types, is presented. Statistical comparisons on the type of incident and the cause and origin of the fire have been evaluated. City areas covered by each police station are also identified. The study's outcomes indicate that more than one-third of the incidents involved motor vehicles, accounting for more than half of all deliberately set fires in Dubai. A further one-third of the incidents reviewed were in residential units. Electrical failures were shown to pose the highest risk of accidental fire, and the Bur Dubai Police Station was the busiest fire investigation caseload. [26]

An article from Nigeria discusses the **user's perspective of fire safety in high-rise buildings** in Lagos. High-rise buildings worldwide are becoming popular due to their capacity to ensure optimum land use, increase urban density, and house more households. Despite the numerous advantages, occupants of high-rise buildings are confronted with fire safety challenges. Given the above, this study examines the perception of high-rise building occupants in Lagos State to ensure fire safety consciousness. A random sampling method was used to gather data from occupants of 1,004 estates through a self-administered questionnaire. One hundred seventy-two questionnaires were obtained from the occupants and used for the analysis. The data were analyzed with a statistical package for social science (SPSS version 17), using frequency and mean score (descriptive statistics). In contrast, correlation analysis (inferential statistics) was used to test hypotheses. The study revealed that fire policy regarding the development of high-rise buildings focuses more on active policies involving the provision of equipment to combat fire outbreaks rather than policies that facilitate easy means of escape. Also, there is a positive relationship between fire safety measures provided by the facility managers and prescribed fire safety standards. That implies that facility managers ensure that occupants know fire safety measures. Their level of compliance with the prescribed fire safety standards in the building increases and, in return, will enhance occupants' safety. This study recommends that investors incorporate more escape methods into the high-rise building's development plan. Also, facility managers should educate the occupants on fire safety measures and ensure their participation in a fire drill or other training related to life safety. Furthermore, the government should set up a regulatory body to monitor and assess fire safety facilities and measures for high-rise buildings. [27]

Another contribution from Africa deals with **evaluating fire protection measures in high-rise buildings in Nigeria** (2017). Fire disasters are one of the world's most common and destructive disasters. Over the years, it has been a disturbing issue to handle, especially in developing countries. This study aimed to evaluate fire safety measures in the design and construction of high-rise buildings in Nigeria. The importance of this study is the evaluation of fire safety measures towards enhancing the safety of occupants and properties. The study comprised a case study survey and questionnaire administration among the building occupants. The occupant survey determines their perceptions of fire safety measures

[26] Mohammad A. Alqassim, Niamh Nic Daeid: Fires and related incidents in Dubai, United Arab Emirates (2006–2013), CAHID, University of Dundee, Dow Street, Dundee DD15EH, Scotland, UK, http://dx.doi.org/10.1016/j.csfs.2014.10.001, 2214-398X/O 2014, Published by Elsevier Ltd.
[27] Temidayo OSUNSANMI et al.: User’s Perspective of Fire Safety in High Rise Buildings in Lagos, Nigeria, Journal of Sustainable Human Settlement and Housing 2017, 1(1): 77-90.

in high-rise buildings and the practicability of measures that could be adopted to improve safety. According to the occupant survey, 88% of the respondents know building fire safety measures. The results also indicated that an electrical fault is the most common cause of fire in high-rise buildings. That could be avoided where electrical conduits and fittings are correctly installed and monitored. The results further revealed the need to improve fire safety measures undertaken by designers and property owners. Careful observance of fire safety measures as specified in building codes must be considered when designing high-rise buildings. [28]

Low-cost high-rise residential buildings have had the highest fire incidents compared to other buildings in Malaysia. This study aims to determine the fire risk status of low-cost high-rise residential buildings in Kuala Lumpur through a fire risk assessment (FRA) approach. The study forms the exploratory phase of more exhaustive research to develop a fire risk indexing (FRI) methodology for low-cost high-rise residential buildings in Kuala Lumpur. On-site fire audits were performed on three (3) selected low-cost high-rise residential buildings in the Pantai area of Kuala Lumpur using a 10-item FRA checklist. The results showed that all 10 FRA criteria recorded multiple issues ranging from the presence of multiple ignition and fuel sources to inadequate or vandalized firefighting equipment to lack of training of occupants on fire risk and safety. Further analysis showed that the fire risk status of the observed buildings was 'high.' A need for immediate intervention measures was established to improve the observed case study buildings' fire safety credentials. Recommendations include reconsidering the design layout of rooms, improving active and passive fire safety protection systems, and training occupants to improve their awareness of fire safety. [29]

Over the past thirty years, an increasing number of UK and international high-rise building fire incidents have emerged to a degree that they can no longer be ignored. The associated issues resulting from detailed investigation demand more effective actions in developing rigorous preparedness strategies. It is unlikely to be fully comprehensive. Nonetheless, a **chronological list identifies numerous serious and often fatal fire-spread incidents in high-rise properties**, compiled from a 2017 online desk exercise covering 1986-2017. [30]

After an**alyzing more than 70 fires in high-rise buildings** in Russia and internationally, **recommendations for fire protection in high-rise buildings** are given. According to international statistics, fires in high-rise buildings are more traumatic and cause more damage than fires in conventional buildings. A fire in a building with more than 25 floors claims 3-4 times more victims than in a building with 9 to 16 floors. At the same time, fires on the lower floors of high-rise buildings lead to greater property damage, and fires on the upper floors lead to greater casualties and deaths. As described in specialist literature, the first fires in high-rise buildings became known in New York City as early as the beginning of the 20th century. In response to these and similar fires, city authorities revised building codes in 1916 to include fire safety and

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[28] Nimlyat, P.S., An evaluation of fire safety measures in high-rise buildings in Nigeria, Sustainable Cities and Society (2017), http://dx.doi.org/10.1016/j.scs.2017.08.035.
[29] Wajdi Akashah, Timothy Kurannen Baaki, and Shing Peng Lee Farid: Fire Risk Assessment of Low-Cost High Rise Residential Buildings in Kuala Lumpur: A Case Study, Centre for Building, Construction and Tropical Architecture (BuCTA), Faculty of Built Environment, University of Malaya (UM), 50603 Kuala Lumpur, Malaysia. Journal of Design and Built Environment, Special Issue 2017.
[30] Ingval Maxwell: High-rise towers fire risk, Compiled June 2017.

firefighting measures such as using fire-safe ladders, firefighting water supply, elevators, and sprinklers. Another problem was highlighted by a fire in New York City in 1970. A fire broke out in a 50-story administrative building that lasted about 6 hours. Two employees died in the fire. They were in the elevator car, which suddenly stopped on the burning floor on the descent, and the doors opened automatically. Nowadays, elevators installed in high-rise buildings are subject to requirements for the installation of vestibule locks (elevator halls with air pressure in the event of fire) before exiting the elevators, requirements for air pressure in the shaft itself, the provision of a power supply according to the first special category of reliability (i.e., use of an emergency electrical generator), etc. as well as fire alarms and serious problems with the water supply. The spread of the fire is to be stopped on the floor where the fire also broke out. That is the task of the sprinkler system. In addition, other circumstances are essential: people's behavior in the building during a fire and whether the fire brigade arrived at the fire object in time. From the analysis of fires emerge the main problems that need to be solved by the developers of regulatory documents, the designers, and the fire safety specialists to ensure the safety of people:

- Ensuring fire resistance of building structures during the time necessary for evacuation and rescue of people, access of firefighters for fire extinguishing, or in case of complete burnout of fire load, without loss of load-bearing capacity of structures. The ability of structures to withstand the maximum design fire scenario by adopting a fire extinguishing system that is inoperable or non-existent.
- Development of a complete set of regulatory documents that determine the fire safety requirements for high-rise buildings.
- Development of a methodological apparatus for monitoring the safety and confirmation of fire resistance parameters of fire-retardant coatings and equipment during operation, considering all influencing factors.
- Limiting the spread of fire in the building by dividing it with fire barriers, using fire doors, dividing the ceiling space into smoke sections, etc., limiting the spread of fire along the façade, ensuring smoke-free escape routes from the building.
- Improving the reliability of the building's engineering equipment, including fire automation systems, elevator equipment, and other systems that affect the safety of people in case of fire.
- Ensuring the integrated safety of the building, taking into account not only the fire as such but also events such as "explosion-fire," "explosion-progressive collapse-fire," "fire-progressive destruction," etc.; making trade-offs between security requirements for different types of threats, such as access control requirements and unimpeded evacuation requirements.
- Informing people about the necessary actions during a fire in a high-rise building. [31]

A paper from Shanghai, China, presents a state-of-the-art review on the design, **research, and education aspects of fire safety engineering (FSE), particularly concerning high-rise buildings**. FSE found its roots after the Great Fire of Rome in 64 AD, followed by the Great London Fire in 1666. The industry revolution, the insurance community, and government regulations continuously drive the development of modern FSE. FSE has become a unique engineering discipline and has been moving towards performance-based

[31] Krivtsov Y.V., Ladygina I.R., Nosov Y.N. Fire in high-rise buildings // Earthquake engineering. Constructions safety. 2018. № 1. C. 20-23.

design since the 1990s. The performance-based fire safety design (PBFSD) involves the identification of fire safety goals and design objectives, establishing performance criteria, and selecting proper solutions for fire safety. Determining fire scenarios and designing fires have now become major content for PBFSD. To experience a rapid and positive evolution in design and research consistent with other engineering disciplines, it is crucial for fire safety engineering to set up a special educational system to deliver the next-generation fire safety engineers. High-rise buildings have unique fire safety issues, such as rapid fire and smoke spread, extended evacuation time, longer fire duration, mixed occupancies, etc., bringing more difficulties in ensuring life safety and protection of property and environment. A list of recommendations is proposed to improve the fire safety of high-rise buildings. In addition, some source information for specific knowledge and information on FSE is provided in the Appendix. [32]

Under "**Flammability and Multi-objective Performance of Building Façades: Towards Optimum Design**," an outstanding fire protection problem in house buildings will be examined in 2018. The façade is an important, complex, and costly part of a building, performing multiple objectives of value to the occupants, like protecting from wind, rain, sunlight, heat, cold, and sound. However, the frequency of façade fires in large buildings is alarming and has multiplied by seven times worldwide over the last three decades to a current rate of 4.8 per year. High-performing polymer-based materials allow for a significant improvement across several objectives of a façade (e.g., thermal insulation, weight, and construction time), thereby increasing the quality of a building. However, all polymers are flammable to some degree. Suppose this safety problem is to be tackled effectively. In that case, it is essential to understand how different materials and the façade perform in the event of a fire. The paper discusses the drivers for flammability in façades, the interaction of façade materials, and current gaps in knowledge. In doing so, it aims to provide an introduction to the field of façade fires and to show that because of the drive for thermal efficiency and sustainability, façade systems have become more complex over time and have also become more flammable. The authors discuss the importance of quantifying the flammability of different façade systems but highlight that it is currently impossible to do so, which hinders research progress. The authors finish by putting forward an integral framework of design that uses multi-objective optimization to ensure that flammability is minimized while considering other objectives, such as maximizing thermal performance or minimizing weight. [33]

High-rise building residents risk becoming the victims of the fire. The risks for the residents associated with the fire are property damage and loss of life. The most sophisticated fire systems do not guarantee safety for occupants if the management of high-rise buildings is lax or complacent. This study aims to identify **aspects of fire safety management that affect occupants of high buildings**, point out the paramount aspect, and describe methods that mitigate risks for users of such premises. The results show whether

[32] Guo-Qiang Li, Chao Zhang, and Jian Jiang (Shanghai, China): A Review on Fire Safety Engineering: Key Issues for High-rise Buildings, The International Journal of High-rise Buildings (IJHRB) Vol.7 - No.4, Date: Dec. 2018.
[33] Matthew Bonner and Guillermo Rein: Flammability and Multi-objective Performance of Building Façades: Towards Optimum Design. International Journal of High-rise Buildings December 2018, Vol 7, No 4, 363-374, https://doi.org/10.21022/IJHRB.2018.7.4.363.

high-rise buildings in the Indonesian capital of Jakarta have followed essential factors based on the city's new regional regulations on fire safety management. [34]

An international team of authors (UK, Australia, South Africa) examines the **construction industry's view of fire protection in high-rise buildings after the Grenfell high-rise fire**. The paper explores contemporary attitudes amongst UK construction professionals regarding fire safety after the Grenfell Tower disaster. Specifically, the research examines practitioners' perceptions of fire safety design, material specification, construction, and maintenance of high-rise blocks throughout a building's life cycle. The methodological approach of the study can be described as follows. A multi-methodology approach was adopted that utilizes a mix of research methods. Extant literature and media content is used as a secondary data source, providing a more insightful interpretive analysis – the results of which guided the development of the survey's main question set. Primary survey data are sourced from structured interviews and questionnaires completed by participating industry professionals and built environment undergraduate students using non-representative sampling methods. In addition, a Grenfell Tower special advisory panel member was interviewed to add further validity to the overall findings. The findings of the study are described as follows. The quantitative findings suggest that the Grenfell disaster (and the media storm surrounding this event) has raised the general level of fire safety knowledge and competency amongst construction professionals. However, qualitative feedback from the special advisory panel members suggests that specific fire prevention knowledge remains elusive within the industry and taught programs at higher education institutes. Consequently, changes in the taught curriculum are proposed together with an extension of the role of facilities managers in practice to cover fire safety in greater depth. What is the value of this examination? The paper provides thoughtful insights into the contemporary discourse on fire safety within the UK construction industry. The research also provides critical suggestions to both industry and policymakers, which seek to prevent a repeat tragedy from occurring again. [35]

In a year-2020 paper, the fire risk assessment of such buildings is studied to prevent fire accidents in high-rise buildings under construction. First, a fire risk assessment index system suitable for high-rise buildings under construction was established based on project investigation and a literature review. Second, the unascertained measure theory was applied to establish a fire risk assessment model for high-rise buildings under construction. The index weight was determined by the entropy weight method. Finally, taking a high-rise building project in Xi'an, China, as an example, the feasibility and rationality of the fire risk assessment index system and assessment model were verified. This research provides a new method for

[34] Tri Kusuma Wardani, Rahmat Nurcahyo, and M. Dachyar: Jakarta Fire Safety System Management Practices for High-rise Building, Industrial Engineering Department, Faculty of Engineering, University of Indonesia, Depok, West Java, Indonesia, 2018 IEEE 5th International Conference on Engineering Technologies & Applied Sciences, 22- 23 Nov 2018, Bangkok Thailand.

[35] Iman Farah Mohamed (Faculty of Engineering and the Built Environment, Birmingham City University, Birmingham, UK), David John Edwards (Faculty of Computing, Engineering and the Built Environment (CEBE), Birmingham School of the Built Environment, Birmingham City University, Birmingham, UK), Monica Mateo-Garcia (Faculty of Engineering and the Built Environment, Birmingham City University, Birmingham, UK), Glenn Costin (School of Architecture and Built Environment, Faculty of Science Engineering and Built Environment, Deakin University, Geelong, Australia), Wellington Didibhuku Didibhuku Thwala (Department of Construction Management and Quantity Surveying, University of Johannesburg – Doornfontein Campus, Doornfontein, South Africa): An investigation into the construction industry's view on fire prevention in high-rise buildings post Grenfell, International Journal of Building Pathology and Adaptation, ISSN: 2398-4708, publication date: November 13, 2019.

objectively assessing the fire risk of high-rise buildings under construction. It provides a reference for controlling the fire risk of high-rise buildings under construction. [36]

The following contribution from Indonesia should be highlighted. Fire incidents negatively affect the function and sustainability of buildings. This study aimed to determine the most critical issues and challenges associated with fire protection for building sustainability in Jakarta. **Fifty high-rise buildings were observed and analyzed**. Data were processed using the AHP, OMAX, and traffic light system methods. The results indicate that, regarding building fire protection systems, only 42% of the total number of high-rise buildings in Jakarta are reliable. In comparison, 40% are less reliable, and 18% are unreliable. The main issues are the unavailability of access for fire officers and poor roads. The inconsistencies are also related to the poor performance of the active and passive protection systems, which, in most cases, fail to function by fire safety standards. The results of this study help increase the awareness and concern of interested parties in building sustainability. [37]

In a technical article from Lebanon (year 2020), the author discusses the **lack of knowledge and implementation in the fire protection field in buildings** with many floors. High-rise buildings are proliferating around the world. They are becoming essential landmarks that mark out certain geographical areas. The fires of high-rise buildings have many characteristics not found in traditional low-rise buildings, like the variety of blazing factors, ways of fire spreading, and difficulty of evacuation. Hence, the protection features of conventional fire methods are insufficient when designing towers. The paper first summarizes the characteristics of high-rise buildings and fires, the unique features of Tall Buildings, and the special life safety requirements for high-rise buildings. Consequently, the implementation of fire and life safety codes during the design and construction phases should be brought to the forefront of the building design process to improve the skills of architectural engineers in integrating safety and fire protection methods. Then, case studies were selected from PETRONAS Tower Malaysia, MARINA Tower Beirut, and BURJ KHALIFA, UAE, designed by various legislations. That shows that there is a direct link between design outcomes and the legislation of buildings. [38]

Historical aspects of high-rise buildings, the statistics of fires in skyscrapers, and the reasons for tragic consequences are considered in an article from Russia. An analysis of the consequences of fires in skyscrapers built at the end of the twentieth century showed that **the factors contributing to the tragic development of fire disasters in high-rise buildings** were:

- low fire resistance of building structures and engineering equipment, especially metal beams and trusses;
- the presence of large internal volumes, not separated by fire barriers;
- a small number of stairwells and a small width of evacuation stairs;

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[36] Li W, Li H, Liu Y, Wang S, Pei X, Li Q (2020) Fire risk assessment of high-rise buildings under construction based on unascertained measure theory. PLoS ONE 15(9): e0239166. https://doi.org/10.1371/journal.pone.023916.
[37] Hary Agus Rahardjo, Morry Prihanton: The most critical issues and challenges of fire safety for building sustainability in Jakarta, Journal of Building Engineering, Volume 29, 2020, ISSN 2352-7102, https://doi.org/10.1016/j.jobe.2019.101133.
[38] Mohamad Abou chakra: The lack of fire safety knowledge and implementation - The case of high-rise buildings, Faculty of Architecture-Design & Built Environment, Beirut Arab University, Beirut, Lebanon.

- the presence of numerous penetrations in the walls and ceilings for air conditioning, electrical equipment, and other technological needs;
- lack of evacuation plans in case of accidents and fires;
- installation of suspended ceilings;
- a lot of combustible equipment, furniture, and cladding.

Several factors complicate firefighting in high-rise buildings:

- the presence of a large number of people in need of help, the occurrence of panic;
- the complexity of rescue operations;
- the spread of fire and toxic combustion products in the vertical direction both inside the building and outside;
- smoke in stairwells and upper floors through elevator shafts and other vertical channels;
- high temperature on the evacuation routes on the floors where the fire broke out (in corridors, stairwells);
- complexity and labor intensity of supplying extinguishing agents, especially to the upper floors of the building;
- the presence of a stylobate around the perimeter of the building and the absence of access platforms, which complicates the installation of ladders and car lifts for rescue operations;
- difficulty in managing a large number of fire vehicles, special equipment, as well as other services involved in firefighting operations;
- the need to use special technical means for rescue operations and firefighting. [39]

A comparative **study on the development of trends of high-rise buildings above 200 meters** in China, the USA, and the UAE from 2021 is attracting attention. Since 2006, the number of completed high-rise buildings over 200 meters has increased rapidly. Although there were some short-term cyclical troughs, the overall trend has still been growing. No longer constrained by technological limits, developing high-rise buildings now depends on cooperation and compromise between social, economic, and political factors. This article extracts statistical data from the Council on Tall Buildings and Urban Habitat (CTBUH) to focus on the completion of high-rise buildings of 200 meters and above over the past 20 years, from 2000 to 2019. Similarities and differences in high-rise buildings' number, distribution, and function are analyzed. The paper also compares the impact of different political and economic environments on the development trends of high-rise buildings in China, the United States, and the UAE. [40]

2021, the book "**Fire Problem in Tall Buildings**" will be published. In a reference book of 17 chapters, a Brazilian team of authors presents the entire spectrum of questions about fires in high-rise buildings. [41]

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[39] A.A. Tarantsev; R.N. Novoselov; A.Y. Rodichev: High-rise buildings and their fire danger. Saint-Petersburg University of State Fire Service of EMERCOM of Russia (published: 2021?).

[40] Jiaqi Qu, Zhendong Wang, and Peng Du: Comparative Study on the Development Trends of High-rise Buildings Above 200 Meters in China, the USA and the UAE, International Journal of High-rise Buildings, March 2021, Vol 10, No 1, 63-71, https://doi.org/10.21022/IJHRB.2021.10.1.63.

[41] Rogério Bernardes Duarte, Rosaria Ono e Silvio Bento da Silva: Fire Problem in Tall Buildings, ISBN 978-65-5872-074-4, ISBN 978-65-5872-075-1.

A publication from Pakistan provides an interesting way of looking at it. The **high-rise building phenomenon** provides the advantage of a better human living environment and urban functions; however, it does come with cons. Fire outbreaks are one of the biggest threats to high-rise buildings. In Pakistan, evaluation of fire outbreaks and prevention is insignificant in the case of high-rise buildings. This study was conducted to assess fire safety awareness and evaluate the current safety measures available in high-rise buildings in Pakistan. The study was based on a quantitative questionnaire on fire safety among the occupants of two high-rise buildings in Lahore, Pakistan. From the survey analysis, it was concluded that one building type has better fire safety measures than the second building type. However, the one sample t-test analysis showed that overall, occupants of both buildings think that their buildings have good defense systems against fire and speedy action is taken in case of a fire outbreak. This study also reveals that the most common causes of fire incidents in high-rise buildings are faulty electrical equipment and negligence of building occupants. That could be avoided by properly fitting good quality electrical cables, installing fireballs in electrical distribution boards, and educating high-rise building occupants on fire outbreak response. A careful observance of fire safety measures as specified in the building codes of Pakistan must be considered in the design of high-rise buildings to avoid any unwanted situations in the future. [42]

Four authors from the United Kingdom present a breathtaking analysis on the topic: **Fire Safety in High-rise Buildings: Is the Stay-Put Tactic a Misjudgment or Magnificent Strategy?** Historically, fire incidents in high-rise buildings reveal that Fire and Rescue Services frequently rely on the stay-put tactic (i.e., occupants of high-rise buildings should remain in their apartments) during an inferno. Recent fire occurrences in high-rise buildings reveal two opposing viewpoints on the stay-put tactic. First, the understanding is that the stay-put tactic is a beneficial practice used to protect, control, and facilitate the smooth evacuation of occupants during fire incidents. Second, the argument is that the stay-put tactic is a misjudgment and futile strategy that leads to fatalities, particularly in high-rise buildings. This study aimed to provide awareness and understanding of fire and rescue services' use of the stay-put tactic in high-rise buildings. The authors attempted to answer the question: is the stay-put tactic a misjudgment or a magnificent strategy? The study adopted phenomenological research strategies with various focus groups of seasoned firefighters and survivors with first-hand accounts of stay-put instructions in high-rise buildings. The study also scrutinized three case studies of fire incidents in high-rise buildings in two countries. The study revealed that the stay-put tactic is obsolete, with the potential to cause catastrophic misjudgment, mostly during conflagrations in high-rise buildings. There is a need to advance research on artificial intelligence communication systems and infrared image detector cameras to enhance quick and smooth fire evacuation in high-rise buildings. [43]

A **Study on Securing Safety for High Rise Building Fires** from Korea (2022) discusses the problem of using **active escape systems**. Under the Korean Enforcement Decree of the Building Act, all high-story apartment

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[42] Jehanzeb, M., Ilyas, U., Ahmad. S. R., (2021): Assessment of Fire Safety Management in High Rise Buildings in Lahore. International Journal of Emerging Technologies, 12(1): 241–246.

[43] Andrew Oyen Arewa, Abdullahi Ahmed, David J. Edwards, and Chizaram Nwankwo: Fire Safety in High-rise Buildings: Is the Stay-Put Tactic a Misjudgement or Magnificent Strategy?, Buildings 2021, 11, 339. https://doi.org/10.3390/buildings11080339.

houses more than 5 stories high must install a fire evacuation system to ensure safe evacuation from fire accidents and provide a quick and easy bi-directional escape route when the main entrance is blocked by flame or toxic smoke. However, the current fire evacuation system shows a lack of understanding from residents and thus is widely ignored for having insufficient safety functions, especially vis-à-vis fire emergencies. Studies have found that an alternative evacuation method, the escapable fire evacuation system, has been analyzed for safety evaluation compared with the conventional passive fire escape system and can bring efficient and safer solutions, providing high-rise residents with escape from fire accidents. Safety evacuation was evaluated using the Fire Dynamics Simulation and Pathfinder simulation. That provided appropriate escape routes within the safety escape time and allowed people in high-rise building fires to get to safety. [44]

A team of experts examines the **safety debate after the Grenfell high-rise fire**. They recall the successes in improved fire protection in the state that have been achieved over many years. Then, the risks of high-rise buildings are considered. The authors then explain the goals, the data used, and the analyses. The following **conclusions** can only be generalized under the condition that the reader or viewer knows the complete presentation:

- Overall trends and averages, as presented in official fire statistics reports, can hide increased fire risks for blocks of flats of certain heights and types that are present in the data;
- Risk increases with height. High-rise is a higher risk. An appropriate precautionary principle should be re-embedded in regulation and practice in association with high-rise residential buildings;
- Fire risk assessors need to be aware and learn from the investigations that followed previous fires and possess a more nuanced, in-depth knowledge of historical incidents and fire statistics;
- The Incident Reporting System is not being used to its full potential and needs reform, as was the case previously, using a feedback loop from stakeholders to improve continually. [45]

A report on **sustainable construction and cases of high-rise building collapse** in Nigeria attracts readers. High-rise residential and commercial development in developing countries like Nigeria has been spurred by both the rapid growth of the population and the pressing need to protect the country's limited land supply in areas of commercial development. However, recent years have seen an increase in the number of building collapses in Nigeria, which is a cause for concern. This study uses statistical methods on historical data to highlight the scenarios of the collapse of high-rise buildings in Nigeria and draw a relationship with it to sustainable construction. According to this study, Nigerian high rises have a low rate of collapse despite the country's high rate of collapse. Still, the number of fatalities in the collapse of these structures is alarming. The high death toll associated with these collapses is a negative indicator of achieving the Sustainable Development Goals of the United Nations (SDGs). [46]

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[44] Myung Sik Lee, Sung Jae Han: A Study on Securing Safety for High Rise Building Fires - Applying Active Fire Escape Systems, The International Journal of High-rise Buildings (IJHRB) Vol.11 - No.3, Date: Sep. 2022.

[45] Dr Stuart Hodkinson, Andy Turner, Phil Murphy: The Fire Risks of High-rise and Purpose-Built Blocks of Flats in England: What Can (and Could) Official Fire Incident Data Tell Us?, University of Leeds.

[46] A.N. Ede, A.J. Akin-Adeniyi, J.U. Effiong, P.O. Awoyera, S.O. Oyebisi, O.G. Mark and C.S. Ezenkwa: Sustainable constructions and cases of high-rise buildings collapse in Nigeria, Department of Civil Engineering, Covenant University, Ota, Nigeria; Building Smart, Resilient and Sustainable Infrastructure in Developing Countries –Musonda & Mwanaumo (eds), 2023, ISBN: 978-1-032-35107-0, DOI: 10.1201/9781003325321-4.

One of the **significant hazards of a fire in high-rise residential buildings in cities is the time taken to evacuate many occupants** completely. On a city scale, a city's fire and rescue services must be in place to minimize the consequences of any potential fire incident. The paper presents the methodology and results of a study that evaluates the **city-wide vulnerability in high-rise residential building fires in the City of Istanbul, Türkiye**. In the context of fire and rescue service arrival to burning buildings, a high-rise building can be considered vulnerable if the fire and rescue service arrives at the building site only after the expected completion of the evacuation of the building, thus unable to fulfill its intended purpose of saving the occupants. The study compares an agent-based evacuation model of safe escape times for 1167 high-rise residential buildings against their fire and rescue service arrival times estimated using GPS data. This methodology can inform the decision about the optimal locations of a city's fire and rescue services. For example, this study indicates that adding a new fire station in the City of Istanbul can improve its preparedness for fire accidents by reducing the risk of its most vulnerable district by more than 26%. [47]

An article from Brazil aims to present a discussion on the concepts of fire safety adopted for the project of **emergency exits in tall buildings** and their relation with the evacuation strategy in case of fire, considering the adequacy of its conception to the type of occupation and the characteristics of the building occupants. The content of this article is based on information obtained from reports and articles developed mainly by renowned researchers and institutions in the international fire safety community. Technical support activities for the changes and improvements needed for a safer and better life for all have been very important in developing countries. [48]

In 2024, an article was published called "**Refashioning Cities in the Middle East: The Case of Dubai**." In recent years, urban landscapes across the globe have undergone a remarkable transformation marked by a substantial surge in skyscraper development. The paper offers a comprehensive overview of the contemporary evolution of tall buildings, with a particular emphasis on the Middle East. It surveys tall building development in the ten "tallest cities" across the Middle East, including Dubai, Doha, Abu Dhabi, Sharjah, Riyadh, Manama, Tel Aviv, Kuwait, Mecca, and Jeddah, while listing the tallest ten buildings in each city. The focus sharpens on Dubai, UAE, serving as a compelling case study that vividly illustrates the city's swift metamorphosis from a low-rise to a high-rise urban center. Through meticulous examination, the study aims to unveil the key drivers propelling the construction of the world's tallest buildings, asserting that globalization factors play a pivotal role in fostering this transformative shift. The impetus behind this surge is the aspiration to project a modern and progressive image on the global stage. With Dubai at the forefront, cities in the Middle East strategically endeavor to reshape their international image and reclaim historical grandeur through ambitious skyscraper projects. [49]

The paper "**Constructing Tall Buildings in China: With a Focus on Shanghai**" examines China's rapid shift from low-rise to high-rise urban development, focusing on Shanghai as a case study. It provides a detailed analysis of the rapid vertical developments over the past five decades, highlighting gradual and sudden tall

[47] Mustapha M. Jodi, Serdar Selamet (both Türkiye), Yong C. Wang (UK): City-Wide Fire Vulnerability Map of High-rise Residential Buildings, Fire Technology, 59, 401–428, 2023.

[48] Rosaria Ono: Emergency Exit in Tall Buildings, Revista FLAMMAE, Revista Científica do Corpo de Bombeiros Militar de Pernambuco, Artigo Publicado no Vol.09 N.26 – I Edição Especial 2023 - ISSN 2359-4829.

[49] Kheir Al-Kodmany (Chicago, USA): Refashioning Cities in the Middle East: The Case of Dubai, The International Journal of High-rise Buildings (IJHRB), Vol.13 - No.1, Date: Mar. 2024.

building changes. The study also surveys tall building development in the ten "tallest cities" across China, including Hong Kong, Shenzhen, Guangzhou, Shanghai, Wuhan, Chongqing, Chengdu, Shenyang, Hangzhou, and Nanning, while listing the tallest ten buildings in each city. The focus is on the drivers behind these towering structures: globalization, an economic powerhouse and finance center, urbanization and population density, architectural innovation and ambition, competition and prestige, land availability and utilization, government support and planning, and tourism. The paper critically examines the sustainability of this trend in light of new Chinese policies restricting the construction of high-rise buildings exceeding 500m and 250m in smaller cities due to safety and security concerns. That prompts a reflection on the long-term viability and implications of the predominantly high-rise trajectory in urban development. [50]

The 2024 book, edited by Alireza Bahrami (Department of Building Engineering, Energy Systems and Sustainability Science, Faculty of Engineering and Sustainable Development University of Gävle, Sweden), includes details on various structures, buildings, and building materials from different structural and sustainability perspectives. It describes how the building industry is vital for achieving sustainable development goals, namely, economic growth, social progress, and the adequate protection of the environment. This collection aims to foster the design and construction of sustainable structures and buildings to reduce the environmental load, connect with the environment, and benefit the health of occupants. Presenting the knowledge, trends, and developments from a group of contributors working with different kinds of structures, structural components, buildings, and building materials, the book is ideal for practitioners working in commercial settings and, engineering students and researchers concerned with sustainability issues. Chapter 1 counts on the **Sustainable Development of Recent High-rise Timber Buildings**, and Chapter 6 counts on **façade fires in high-rise buildings** - Challenges and Artificial Intelligence Solutions. [51]

[50] Kheir Al-Kodmany (Chicago, USA): Constructing Tall Buildings in China: Focusing on Shanghai, The International Journal of High-rise Buildings (IJHRB), Vol.13 - No.1, Date: Mar. 2024.
[51] Alireza Bahrami (Editor): Sustainable Structures and Buildings (2024), ISBN-10 303146687X, ISBN-13 978-3031466878.

Resumé: ***Development of high-rise buildings***

- **High-rise building phenomenon:** High-rise buildings are products of our time. They solve demand problems while creating new problems. In recent decades, industrialized countries have developed into centers for high-rise buildings. Land is scarce and expensive, especially in large cities in Asia and North America, where tall buildings are the best solution to the need for space for offices, residential, etc.
- **Refashioning cities in the World**: High-rise buildings have changed the skyline of big cities. The advantages of using small areas and their arrangement in height optimize many processes, but they also cause new technical problems.
- **Constructing tall buildings**: High-rise buildings pose various challenges for architects and urban planners. The following points are to be mentioned as examples: assessment of the site and compliance with regulations, the integrity of the structure, and mechanical/electrical/plumbing infrastructure. Other important technical and organizational details are lighting, elevators, telecommunications infrastructure, heating, cooling, water supply, fire protection, ventilation and air conditioning, and waste disposal systems.
- **High-rise buildings above 200 meters**: As the number of floors increases, new challenges appear, as do the technical challenges, such as soil loading, selection of building materials, wind load on the building, and earthquake resistance, to name just a few.
- **Fire problem in tall buildings**: Fire safety problems have already arisen in the construction phase of high-rise buildings (many technical security systems have not yet been installed). Fire safety provisions in ultra-high-rise buildings are of particular importance.
- **Low-cost high-rise residential buildings:** Price pressure during the construction of high-rise buildings also continues for the useful life of the building. Since small-scale apartments tend to be rented out in low-cost buildings, the number of people per floor is increasing. Vandalism is a common cause of defects in elevator systems, waste disposal systems, and the use of cheap products in household appliances.
- **Development of recent high-rise timber buildings:** Wood has historically been a very extensively used building material. At present, wood is also increasingly being used to construct high-rise buildings. There are such high-rise buildings with a height of up to 80 m, but in the future, for example, buildings with a height of 350 m are being planned in Japan.

Resumé: ***Problem of emergency evacuation***

- **The movement of people on stairs during a fire evacuation exercise** is a very serious and extensive matter. The question of how this is done with people of increasing age and with people with disabilities must be investigated.
- **People on stairs move from top to bottom during a fire evacuation**. In contrast, rescue forces move from the bottom to the top.
- **Concept on emergency total evacuation by lifts**: in very tall buildings, the evacuation of persons is planned using elevators. In ultra-tall buildings, the elevators move in sections, i.e., not over the entire height of the building.
- **Significant hazards in a fire in high-rise residential buildings** include the time it takes to evacuate many occupants completely. Various concepts consider either only the stairwells or only the elevators.
- **Smoke escaping from the doors**: The most common fire outbreak site is assumed to be an apartment unit or an office space. Therefore, the functionality of the doors on the floors is of great importance.

Resumé: ***Fire accidents***

- **Fire situation regarding high-rise buildings**: an increasing number of publications describe the fire situation. The topic is not only current but also very complex.
- **Chronological lists show numerous severe and often fatal fires in rare high-rise buildings**. Such a list can best be compiled from media reports. However, only spectacular events in particularly tall high-rise buildings are usually depicted there. In most cases, fire incidents are absent in buildings with up to 15 floors.
- **The situation of high-rise fires in a single country**: such analyses and evaluations have been rare. However, such publications are becoming more frequent, as it has been recognized locally that high-rise disasters are a significant social problem.
- **Problem of fire risks in high-rise buildings**: The dangers associated with operating high-rise buildings are manifold. Particular attention is paid to those buildings that are used as hotels, residential buildings, or hospitals.
- **Factors of high-rise fires, their causes, and corresponding fire protection measures**: Various technological and social factors determine the course of any fire incident. In particular, it should be pointed out that deficits in the building's planning, construction, and usage concept must not be transferred to the fire brigades. The fire brigade's resources are limited.
- **Fire accidents in high-rise buildings under construction** are particularly complicated because the security infrastructure has not been installed or is not yet in operation.

Resumé: ***Fire causes***

Fire causes are, in most cases, similar for all other buildings.

- Explosions.
- Bomb attacks.
- Aircraft.
- Cooking.
- Electricity.
- Smoking, fireworks.

Resumé: ***Fire safety education***

- Planners, users, and residents of hire-rise buildings must know that an **active fire protection system** requires an action to detect, respond to, contain, or suppress a fire in a high-rise building. Many building residents or employees believe only manual actions, such as dousing flames with a fire extinguisher, count as active fire protection. That's not true. However, active fire protection systems merely require an action—whether manual or automated. An active fire protection system incorporates fire detection (Heat detectors, smoke detectors, flame detectors, fire alarm systems, and fire suppression components. Fire suppression systems include sprinkler systems, fire extinguishers, and other components. The proper mix of systems for the high-rise building depends on the size, use, construction materials, and local and national regulations. That hopefully allows people to evacuate the building safely until the fire service arrives.
- Planners, users, and residents of high-rise buildings must know **that passive fire protection systems** protect a building against fire without needing a specific operational action. The key elements of passive fire protection systems are fire-resistant walls, heavy-duty fire doors, and fire-resistant glass.
- **Fire education** is linked to people's awareness of fire protection, human behavior, the special user's perspective of fire safety in high-rise buildings, and educational aspects of fire safety engineering.

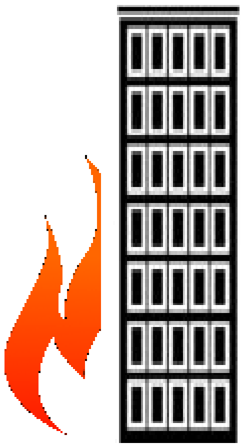
Resumé: *Fire protection measures* must be focused on

- Safety debate after the Grenfell high-rise fire.
- Construction industry's view of fire protection in high-rise buildings.
- Review all recommendations for fire protection in high-rise buildings.

Resumé: *Firefighting*

- Several factors complicate firefighting in high-rise buildings.
- High-rise building fires extend to upward floors via windows.
- Technical possibilities are limited (turntable ladders, aerial platforms, helicopters, drones).
- Firefighting tactics should be under review after the Grenfell high-rise fire.
- Façade fires – a new challenge for the fire brigades.

3.0 Selected Case Studies about International High-rise Fires



In this section, we would like to remind the reader of some fires in high-rise buildings that have become engraved in the general memory due to local peculiarities and technical details. The statements were made as short as possible. We list 113 fires in total. Comments are added at the end of the section.

- The Asch Building Fire disaster, known as **The Triangle Shirtwaist Factory fire** in Manhattan, **New York City, on March 25, 1911**, was the deadliest industrial disaster in the city's history and one of the deadliest in U.S. history. The fire started on the top three floors of the 10-floor Asch Building, now known as the Brown Building. The fire killed 146 garment workers. The fire led to wide-ranging legislation requiring improved factory safety standards. The building survived the fire and was refurbished.
- **New York (USA). 28.07.1945**: 14 people are burned alive, and 26 are severely burned when a B-25 bomber crashes into the 102-story building of the **Empire State Building** in New York City in foggy conditions. Four floors of the building burned out - from 75 to 79. [52]
- **Atlanta (Georgia, USA), 07.12.1946**: 119 people were killed and 91 injured when the Winecoff Hotel caught fire. The 15-story building housed about 300 guests and staff. The fire was noticed too late, and people did not have time to evacuate. [53]
- **São Paulo (Brazil, 01.02.1974):** A fire in the 25-story Joelma Building killed 227 people and injured 450. The fire broke out on the 12th floor in a ventilation pipe and quickly spread through the building, which was covered with flammable material. The cause of the fire has not been established.
- **Katrantzos Sports Department Store in Athens (Greece) was set in flames by arsonists on December 19, 1980**. The eight-story reinforced concrete building was destroyed. The fire started on the 7th floor and rapidly spread throughout the building due to a lack of vertical and horizontal compartmentalization and an automatic sprinkler system. Collected evidence indicated that fire temperatures reached 1,000 C over the two-to-three-hour fire's duration. Two floors (the 5th and 8th) suffered partial collapse. [54]
- **Las Vegas (Nevada, USA, 21.11.1980):** 87 people died, and 679 were injured by fire and smoke in a fire at the MGM Grand Hotel. The cause of the fire in the 26-story building was a short circuit in the electrical wiring.
- **Las Vegas (Nevada, USA, 11.02.1981):** Eight people are fire victims, and 252 are injured at the Hilton Hotel. A fire caused by a short circuit broke out on the eighth floor of a 30-story building. At the same time, the fire protection system was turned off due to the ongoing modernization.
- **San Juan, Puerto Rico, 31.12.1986):** The building has 20 non-sprinkled floors. Ninety-seven people died, and 140 suffered burns of varying severity when a fire engulfed the 30-story DuPont Plaza

[52] A.A. Tarantsev; R.N. Novoselov; A.Y. Rodichev: Highrise Buildings and their Fire Danger. Saint-Petersburg University of State Fire Service of EMERCOM of Russia.

[53] A.A. Tarantsev; R.N. Novoselov; A.Y. Rodichev: Highrise Buildings and their Fire Danger. Saint-Petersburg University of State Fire Service of EMERCOM of Russia.

[54] https://www.photiadis.gr/katratzospor-dept-stores-athens/.

Hotel for 12 minutes. The source of the fire was cardboard boxes in one of the hotel's rooms. According to one version, there was a deliberate arson.[55]

- **Prudential Tower (Boston, USA), January 2, 1986**: A nine-alarm fire in the building spread because of the lack of a sprinkler system.
- **The Alexis Nihon Plaza in Montreal, Canada (1986)** is a 15-story steel-frame office building built atop a five-story concrete mall and parking garage. The beams and floors had a three-hour fire rating, while the columns had a two-and-a-half-hour rating. All building elements were insulated with spray-applied mineral fiber fireproofing. There was no automatic sprinkler system installed in the building. Approximately five hours after the fire started, a section of the 11th floor collapsed onto the 10th floor. The steel structure did not collapse.
- **Schomburg Plaza, New York, USA (1987)**: The building has 35 floors. The fire started between the 27th and 29th floors and traveled up a trash chute and through the walls into surrounding apartments. Investigations found that sprinklers in the chute either failed to work because they were clogged or were not connected to the piping system.[56]
- An **office high-rise building** of the Companhia Energética de São Paulo (CESP) went up in flames in **Sao Paulo (Brazil, 21.05.1987)**. The "Sede 2" was a 21-story reinforced concrete-frame office building with no sprinklers. After a two-hour fire, a partial, full-height interior core collapsed. Structural damage required that the building be demolished. The fire spread to three neighboring buildings. There were no casualties. [57]
- **First Interstate Bank, Los Angeles, USA (1988)**: The building has 62 floors. The fire source was believed to be electrical on the 12th-floor open-plan office. Except for the central core passenger lift lobby, the fire quickly grew over the 12th floor and spread to the 16th floor through the gaps between the external cladding and floors. All external cladding from the 12th to 16th floors was destroyed and, becoming detached, fell off. Excluding business interruption, the loss was estimated at over $200 million. [58]
- **June 30, 1989**: The 10-story **Peachtree Building fire in Atlanta, Georgia (USA)**, resulted in the death of five building occupants while injuring 20, including six firefighters. [59]
- **Cairo (Egypt, 15.03.1989):** A fire broke out on the top three floors of the 28-story skyscraper of the television center in Cairo, which quickly spread due to strong winds. Two people were killed, eight were injured, and four were rescued with the help of helicopters.
- **Meridian Building, Philadelphia, USA (1991)**: One of the largest high-rise office building fires in modern American history started on the 22nd floor (there are 38 floors). It consumed eight floors

[55] http://www.nfpa.org/news-and-research/fire-statistics-and-reports/fire-statistics/fires-by-property-type/high-rise-building-fires.

[56] http://www.thecompanyofficer.com/2011/02/23/one-meridian-plaza-high-rise-fire-twenty-years-ago/.

[57] A.A. Tarantsev; R.N. Novoselov; A.Y. Rodichev: Highrise Buildings and their Fire Danger. Saint-Petersburg University of State Fire Service of EMERCOM of Russia.

[58] http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/HistoricFires/BuildingFires/interstateBank.htm.

[59] http://skyscraperdefense.com/?page_id=46.

and was only controlled when it reached one protected by automatic sprinklers. [60] Three firefighters died during extinguishing. [61]

- The fire in the **Leningrad Hotel occurred on February 23, 1991, in Leningrad** (now **Sankt Petersburg, Russia**). As a result of the fire, which broke out on several floors of the hotel, 16 people died, including nine firefighters, and more than 36 injured persons.
- **Knowsley Heights Apartment Block, Liverpool (UK, April 5, 1991)**: A fire was deliberately started in a rubbish compound outside the 11-floor block and spread rapidly through a 90 mm gap between the building's rubberized, paint-covered concrete outer wall and recently installed rain screen cladding. The fire reached the highest floor, seriously damaging the outer walls and windows. The rapid spread was caused by a lack of fire barriers in the cavity gap, which provided a flue for hot gases to rise. [62]
- **Bijlmermeer Apartment Complex Fire**: On **October 4, 1992**, a Boeing 747F aircraft nose-dived from the sky and slammed into two high-rise apartment complexes in **Amsterdam (Netherlands)**. The impact of the aircraft hitting the corner of the 9-floor building containing 200 apartments partly collapsed inward. The plane crash resulted in the death of 43 people.
- **London (England, UK, 17.01.1996)**: Approximately 500 people were evacuated from a skyscraper in the City of London. The cause was an intense fire that broke out on the 45th floor of the building.
- **Milan (Italy, 13.02.1996)**: A severe fire broke out in the city's business center. The fire engulfed the upper floors of the 27-story Torre Velasca business center. It arose due to electrical equipment malfunction during construction work in the business center's offices. No one was injured.
- **New York (USA, 10.10.1996)**: A fire broke out at the headquarters of the national television company NBC in one of the skyscrapers at Rockefeller Center. All people in the 70-story building were evacuated, and several people were injured by smoke. The cause was a malfunction in the electrical wiring on the 10th floor.
- A remarkable fire occurred in the 20-story high-rise apartments on **October 28, 1996, in Hiroshima (Japan)**. The fire started from an apartment on the 9th floor and spread up to the top floor, 20th floor, very quickly (in less than 30 minutes) by the external flame spread through balconies. As many occupants have lived there since it was built in 1972, about half are aged. In this fire, the occupants were forced to evacuate in smoke-filled conditions because of the rapid upward fire spread. Still, very fortunately, there was no fatality, with only two injured. The Motomachi high-rise apartment is a 20 20-story reinforced fire-resistive building with a total 172,000 square meters area and about 3,000 households. This apartment building has a so-called skip-floor style design (the style in only even-numbered floors has a common corridor to the stairs hall of each block, so people on odd-numbered floors have to use the private stairs down to the common corridor of the lower even-numbered floor). [63]

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[60] http://www.philly.com/philly/news/One_Meridian_Plaza_fire_1991.html?photo_24.
[61] A.A. Tarantsev; R.N. Novoselov; A.Y. Rodichev: Highrise Buildings and their Fire Danger. Saint-Petersburg University of State Fire Service of EMERCOM of Russia.
[62] http://discovery.nationalarchives.gov.uk/details/r/C11197377.
[63] Ai Sekizawa, Shinji Nakahama, and Yuka Ikehata: Study on Feasibility of Evacuation by Elevators in a Highrise Building - A Case Study for the Evacuation in the Hiroshima Motomachi Highrise Apartments -, http://www.iafss.org/publications/aofst/4/217/view/aofst_4-217.pdf

- **Hong Kong (China, 21.11.1996)**: The fire in the Garley Building is considered the worst in history. Forty people were killed and 81 injured in a 20-hour fire in the 16-story Harley Building. Seven floors were completely burned out. The fire caused a short circuit in the electrical wiring.
- **Bangkok (Thailand, 23.02.1997)**: A fire broke out in the 36-storey President Tower building. Floors from the 7th to the 10th burned to the ground, and three people died. [64]
- **New York (USA, 05.12.1997)**: A transformer on the 74th floor of the 77-story Chrysler Building in New York City caught fire. There were no casualties.
- **Jakarta, Indonesia, 08.12.1997**: A massive fire broke out on the upper floors of a 25-storey Bank building. The top three floors burned out completely. At the time of the fire, over 200 bank employees and workers were in the building where the finishing work was carried out. Fifteen people died. The cause of the fire was a short circuit in the air conditioning system.
- **Hong Kong (China, 10.12.1997)**: A fire broke out on the 24th floor of the Melbourne House downtown. There were no casualties.
- **London (England, 22.03.1998)**: A fire broke out in the city's center. Almost a fifth of the 40-meter tower, on the upper floors of English billionaires' apartments, burned out completely. There were no casualties among the population; one of the firefighters received severe burns.
- **Garnock Court, Irvine, Scotland (UK)**: The 14-story residential tower burned on **June 11, 1999**. The fire started in a flat on the fifth floor. Within minutes, it burst through the flat window. Seconds later, onlookers reported that a vertical ribbon of cladding on one corner of the block was ablaze. Ten minutes after that, the flames had reached the 12th floor. The cladding on the outside of the building was suspected of contributing to the fire's severity, and concerns were raised that housing blocks around the country could be at risk. That triggered a parliamentary inquiry into the extent of the problem, which was carried out by the Environment, Transport and Regional Affairs Select Committee. [65]
- **Philadelphia (Pennsylvania, USA, 05.01.2000)**: A fire broke out on the roof of a 32-story building downtown. No one was injured.
- **Hong Kong (China, 02.08.2000)**: A fire broke out on the 13th floor of Hong Kong's Immigration Tower. Forty-seven people received severe burns.
- **Moscow, Russia, 28.08.2000**: Europe's tallest structure, the Ostankino TV Tower, was engulfed in fire. For some time, television broadcasts throughout Russia were stopped. Three people were killed. [66]
- **High-rise Condominium, Clearwater, Florida, USA (2002)**: The fire originated in a 5th-floor apartment kitchen of an 11-floor building. Firefighters encountered several problems, including radio communication issues, closed standpipe riser valves, and a damaged fire hydrant. The fire caused $4m worth of damage and was retrofitted with sprinklers. [67]
- **January 2002**: Fire on the 14th floor of the 44-story building at 260 East Chestnut (**Chicago, USA**) kills one and injures 11, including eight firefighters. [68]

[64] http://skyscraperdefense.com/?page_id=46.
[65] http://www.building.co.uk/cladding-the-new-rules/1000582.article.
[66] http://news.bbc.co.uk/2/hi/europe/898878.stm.
[67] http://www.thecompanyofficer.com/2011/02/23/one-meridian-plaza-high-rise-fire-twenty-years-ago/.
[68] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.

- **Hamilton, Ontario, Canada (2002)**: Apartments went up in flames. The Jackson Street Apartments is a **21-story reinforced concrete apartment building** that experienced a fire on one floor. After the fire was extinguished, all residents of the building except those on that floor were eventually allowed to return to their units. Fragments of concrete, as well as lath and plaster, were reported to have injured several firefighters, but no fatalities were reported. A floor/ceiling assembly in the apartment building partially collapsed.
- An apartment block **in Sankt Petersburg (Russia, 2002)** was a **nine-story concrete structure that collapsed after a**n approximately one-hour-long fire. The news services reported only one related casualty. About 400 other residents were safely evacuated from the burning building before the collapse.
- **Petershill Court, Red Road, Glasgow (UK, 2003)**: A serious fire broke out in a flat on the 21st floor of the multi-story tower block (with 24 floors total), and 28 families were evacuated, and 18 families had to be rehoused in the short term. The flat was severely damaged. [69]
- **Johannesburg, South Africa, 05.03.2003**: 6 people were killed, and 67 were burned and injured in a fire at the Rand Inn International Hotel. The fire began to spread from the first floor of a 21-story building due to a spark in the restaurant's kitchen.
- **Chicago (USA, 17.10.2003)**: 6 people died in an office building in the city center. The fire started at the end of the working day on the 12th floor of a 35-storey building. The cause of the fire has not been clarified.
- A **fifteen-story building in Cairo (Egypt, 2004)** was a reinforced concrete structure that collapsed after a fire broke out in Souq al-Wahda, a small appliance store on the ground floor. When the building was constructed in 1981, it had eleven floors, but the owner had illegally added four more. An order from the city to tear down the extra floors was never executed. Six days before the blaze, tenants complained to police that renovation in the appliance store could damage the building's foundations. As a result of the fire, the building completely collapsed.
- **Caracas (Venezuela, 17.10.2004)**: A fire destroyed a third of the tallest 56-storey skyscraper, Parque Central, in South America. Twelve firefighters were burned and injured. [70]
- **Chicago (USA, 06.12.2004)**: A fire (started by faulty wiring) occurred on the 29th floor of the historic La Salle Bank high-rise at 135 S. LaSalle Street in the downtown Loop business district. The fire injured 37 people (22 of which were firefighters). Over 300 firefighters (and one-third of the city's fire equipment) battled the blaze for over 5 hours. [71]
- **Windsor Tower, Madrid (Spain, 2005)**: The commercial Tower's original structural design, with 32 floors, complied with the 1970s Spanish building codes, but these did not require fire protection for steelwork and sprinklers. The building was subjected to a 3-year refurbishment program when the fire broke out on the 21st floor and spread to all floors above the 2nd-floor level. The building was beyond repair and had to be demolished. [72]

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[69] http://www.kirkintilloch-herald.co.uk/news/families-forced-to-flee-as-fire-breaks-out-in-tower-block-1-363470.
[70] http://skyscraperdefense.com/?page_id=46.
[71] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[72] http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/HistoricFires/BuildingFires/default.htm.

- **Harrow Court, Stevenage (UK, 2005)**: A tea-light candle left burning whilst the occupants were asleep possibly caused the fire. It occurred in a 14th-floor flat; an examination of the burning patterns indicated that it was fed by high wind gusts. This forced an intense fire to burn inside the flat. Two firefighters and one occupant died. [73]
- **Tohid Town Residential Fire: On December 6, 2005**, an Iranian military transport aircraft was returning towards the Persian Gulf when, for reasons still unknown, it crashed into a **10-floor apartment building in Tehran (Iran)**. The death toll is in dispute between agencies, but the final figure is between 116 and 128 people. All 94 aboard the plane died. Along with those on the plane, 34 on the ground were killed, with 90 more injured.
- In **May 2006, the 37-storey Transport Tower in Astana** caught fire. At that time, the tallest administrative building in Kazakhstan housed the Ministries of Transport and Communications, Culture and Information, Sports and Tourism. Initially, the fire broke out on the upper floors; then, the fire spread very quickly over the entire façade. The highest fire brigade turntable ladders that arrived on site reached the level of the tenth floor. Construction work is cited as the probable cause of the fire.
- In **April 2007**, a fire broke out in the **Ducat Place III business center in Moscow (Russia)**. As the inspection later showed, the façade of the building was lined with aluminum composite panels with a degree of flammability of G4 ("highly flammable").
- In **July 21, 2007**, the façade of the 24-storey **Atlantis 2 administrative and residential complex** was on fire in **Vladivostok (Russia).** The reason is called careless handling of fire during roofing work, resulting in drops of burning bitumen falling into the air gap of the façade. The fire, which started at the level of the 19th floor, spread down the building in a matter of minutes. In half an hour, five floors were completely burned out. It was possible to avoid casualties only because the building was not put into operation at that time. The façade of the Atlantis 2 residential complex was lined with aluminum composite panels.
- **TU Delft Faculteitsgebouw Bouwkunde (Delft, The Netherlands, April 13, 2008)**: A broken water pipe on the 8th floor caused a short circuit in a coffee machine a floor below, resulting in a fire.
- **Abraj Al Bait Towers (Hajar Tower), Mecca (Saudi Arabia, October 28, 2008)**: A fire occurred during construction. Firefighters were doing heavy work to put out the fire, which burned for 10 hours and consumed nine floors of the tower.
- **February 9**, 2009: A fire in the newly constructed **44-story Mandarin Oriental hotel in downtown Beijing (China)** turned the building into a towering inferno. However, the skyscraper remained standing. One firefighter died, and six others were injured. [74]
- In the summer of **2009**, the top ten floors of a 27-storey **residential building** on Babushkina Street in **Moscow (Russia)** burned out. In the new building, which was not commissioned at the time of the fire, aluminum composite panels were burning. The cause of the fire was the use of low-quality cladding material at the facility and errors in installing the ventilated façade.
- **Waddell Court, Gorbals, Glasgow (UK, 2009)**: A 61-year-old man died after a fire in a fifth-floor flat of a high-rise block. [75]

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[73] http://www.highrisefirefighting.co.uk/case/harrowct/Harrow_Court_4_Paul_Grimwood_Final_Report.pdf.
[74] http://skyscraperdefense.com/?page_id=46.
[75] http://www.scotsman.com/news/man-killed-as-fire-breaks-out-in-gorbals-tower-block.

- **Lakanal House, Camberwell, South London (UK, 2009)**: On July 3, 2009, a faulty TV caught fire on the ninth floor of the 14th-floor block. The flames spread up and down the building, trapping people in their flats. Six people died in the council-owned tower block. In February 2013, the Inquest findings into their deaths found opportunities to prevent the tragedy were missed. The research report on the 11-week inquest and its verdict, published on-line at Inside Housing, indicated that changes in social landlords' approach to fire safety would be required. [76]
- **December 10, 2009**: a fire on the thirty-sixth floor of the building at 260 East Chestnut (**Chicago, USA**) claimed the life of an 84-year-old woman and injured 12 others. Before the fire, this building passed the City of Chicago LSE (Life Safety Evaluations). [77]
- **Madingley, Cambridge Estate, Kingston upon Thames (UK, 2010)**: The block of 60 flats housed up to 150 people. A fire was deliberately started in a 12th-floor flat and spread to the upper floors and roof. Evacuated residents were subsequently transferred to temporary accommodation. The block required extensive refurbishment, and the residents did not return until nine months after the incident. [78]
- **Wooshin Golden Suites in Busan (South Korea, September 1, 2010)**: A spark from an electrical outlet started the fire on the fourth floor, rapidly spreading to the top of the building via external combustible cladding.
- **Shanghai Apartment Tower, China (2010)**: A devastating fire in an apartment tower has raised concerns about the safety risks of China's ongoing building boom. Authorities say a spark from an unlicensed welder's torch ignited the blaze in the 28-story building. The fire raged for four hours and killed at least 53 people, with 47 still missing four days later. [79]
- **Adamson Court, Lochee, Dundee (Scotland, UK, 2011)**: This building has 15 floors. Because of the ferocity of the fire on the 14th floor, it spread to the flat above and caused considerable damage. [80]
- **Dynasty Wanxin building complex Towers (Hotel), Shenyang (China, February 3, 2011)**: A fire started from fireworks. Firefighters had trouble dealing with the fire because their fire engines shot water up only 165 feet, while the building was 720 feet tall.
- **Overtoun Court, Swinton Street, Clydebank (Scotland, UK, 2011)**: In a building with 14 stories, a 4th-floor fire leads to one fatality. [81]
- **Salamanca Place, Lambeth (England, UK, 2011)**: A fire broke out on the 4th floor of a 17-story building. Firefighters rescued nine people externally, and ten more residents were led to safety down internal staircases. [82]
- **Andrew Reed House, Linstead Way, Wandsworth (London, UK, 2011)**: A fire broke out on the 9th floor of a 15-story residential building. Within minutes of arriving, fire crews rescued five people

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[76] http://www.insidehousing.co.uk/lakanal-house-the-verdict/6526499.article.
[77] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[78] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf.
[79] http://content.time.com/time/world/article/0,8599,2031985,00.html.
[80] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf.
[81] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf.
[82] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf.

using the stairs and four people from the 10th floor via a turntable ladder. A further 150 people were evacuated. [83]

- **Clem Attlee Estate, Fulham (London, England, 2011)**: In a 17-floor residential building on the 6th floor, a massive fire broke out. 25 residents evacuated. [84]
- **Markham Tower, Bowers Avenue, Mile Cross, Norwich (England, UK, 2011)**: In a 10-floor building, a massive fire broke out. The fire started in an 8th-floor flat when a resident was absent. It filled the block's upper levels with smoke and began to affect the floor above before being extinguished. One flat was badly fire-damaged, and 10 others water-damaged. The apartments were fitted with high-rise towers fire risk: battery-operated smoke detectors and the block had an up-to-date fire risk assessment but not a sprinkler system. [85]
- **Marine Tower, Abinger Grove, Deptford, South London (England, UK, 2011)**: Over 100 firefighters fought the fire that was started deliberately in a flat on the 16th floor of a 17-floor building. Crews rescued two women from another flat on the same floor, but sadly, both were pronounced dead at the scene. An online report by the London Fire Brigade noted: The investigation by fire safety officers revealed serious safety failings relating to the failure to maintain fire doors, which directly contributed to the spread of the fire. The flat where the fire started was fitted with a metal security door, preventing the existing fire door behind it from being closed. The severity of the fire and the lack of protection between the flat where the fire started and the building's communal areas meant fire and smoke rapidly entered the lobby and also the adjacent flat in which the two women who died were trapped. [86]
- **Uncompleted high-rise block in Kuala Lumpur (Malaysia, January 18, 2012)**: building under construction. It took the fire service at least one and a half hours to set up a (water) pump and hoses on the 25th floor to finally combat the fire effectively.
- **Swiss Cottage, North London (England, UK, 2012)**: Fire crews were called to tackle a blaze in a 22-storey Swiss Cottage tower block on January 16, 2012. Eight fire engines and around 40 firefighters were sent to deal with the incident. The fire gutted a four-room flat on the 17th floor, and 130 people were evacuated from the building to a local community center. With many people inside the building, fire crews worked extremely hard to get the fire under control and confine the fire to just one flat on the seventeenth floor. No one was injured, and the cause was accidental, believed to be the result of a candle setting some papers alight. [87]
- In **2012**, a fire broke out in the **Sun City multifunctional complex in Novosibirsk (Russia)**. The cause of the fire in the 23-storey building was a violation of safety requirements during work on the roof. The vapor barrier film included in the system of the hinged ventilated façade was burning.
- **Tamweel Tower, Jumeirah Lakes Towers, Dubai**: A 34-floor high-rise building caught fire on **November 18, 2012**. The fire broke out at around 2 AM and was extinguished around 7 AM. The tower was partially gutted as a result, and an estimated 160 property owners were unable to occupy or rent their apartments. A dropped cigarette outside the building caused the fire,

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[83] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf
[84] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf
[85] http://www.bafsa.org.uk/pdfs/publications/1/00000111.pdf
[86] http://www.london-fire.gov.uk/news/LatestNewsReleases_Fatalhighrisefireshouldbewakeupcallsays.asp - WUfngcbMxBw.
[87] http://www.london-fire.gov.uk/LatestIncidentsContainer_16Jan12m.asp.

triggering the non-fireproof cladding to burn up the building's height in 10 minutes. There were no casualties. The cost of repairing the tower was $13.5 million. [88]

- **Polat Tower, Istanbul, Türkiye (2012)**: The 42-floor Polat Tower in Istanbul's Fulya business district has residential flats and offices, and a faulty air conditioner may have triggered the blaze. The building's fire-extinguishing system automatically activated, and the inside of the tower had not been damaged. [89]
- **Al Nahda Tower, Sharjah, UAE (2012)**: This incident, which occurred on April 28, 2012, in a 43-floor building, came 95 days after a fire ravaged a 25-story residential high-rise, also in Sharjah, leaving 125 families homeless. [90]
- **Mermoz Tower, Rue Dunant, Roubaix, France, went up in flames on May 14, 2012**: One person died, and ten others were injured in a fire that spread rapidly upwards from a second-floor flat to the top of an 18-story tower block in Roubaix, France, apparently via its flammable outer cladding, penetrating other apartments. The fire affected four apartments, but all 250 residents were being rehoused locally. The building, also known as the Aviator Tower, was reportedly owned by a social landlord organization. [91] [92]
- **Grozny-City Tower Olympus Hotel, Chechnya (Russia, 03.04.2013)**: The fire took hold on one side of the 40-story building and burned the façade for approximately 8 hours. Water from the fire engines only reached the tenth floor of the building. A total of 58 fire engines and 350 firefighters were mobilized to extinguish the fire. No one was killed or injured. [93]
- Deadly blast at the **Mexico City (Mexico, January 31, 2013)** headquarters of the state oil company, Pemex. Afternoon's explosion in the lower floors of a building adjoining the **54-story skyscraper** happened as shifts were changing, making the area exceptionally crowded. Some 500 rescuers helped by dogs are searching the building for people believed missing after the explosion that killed 32 people and injured 100. Twenty women and 12 men were killed in the blast, while 52 of 121 others who were treated for their injuries remained in hospital. [94]
- **March 24, 2013**: The residential high-rise building at 2626 N. Lakeview Avenue (**Chicago, USA**) experienced its third major fire in six years. The first fire killed two residents on January 26, 2007, while the second occurred on October 25, 2012. [95]
- Eight plunges to death as fire erupts at **high-rise building in Lahore (Pakistan, May 9, 2013)**: A fire erupted at the LDA plaza situated on Lahore's Edgerton Road, killing eight persons, injuring and trapping several others inside the building. The fire erupted around noon, started on the 7th and 8th floor of the building, and rapidly engulfed three more floors. A man reportedly fell from the seventh floor of the 13-story building while escaping the fire and died on the spot. Similarly, two others jumped out in the hope of escaping but later succumbed to injuries at the hospital. The

[88] http://www.thenational.ae/news/uae-news/tamweel-tower-fire-started-by-cigarette-butt-say-dubai-police.
[89] https://www.rt.com/news/istambul-sky-scraper-fire-362/.
[90] http://gulfnews.com/news/uae/emergencies/fire-breaks-out-at-sharjah-tower-1.1014750.
[91] http://www.blog.plumis.co.uk/2012/05/high-rise-blaze-in-18-storey-block-in.html.
[92] https://france3-regions.francetvinfo.fr/hauts-de-france/2013/05/14/roubaix-un-apres-l-incendie-de-la-tour-mermoz-251227.html.
[93] https://en.wikipedia.org/wiki/Grozny-City_Towers.
[94] https://www.bbc.com/news/world-latin-america-21289850.
[95] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.

rescued persons were shifted to the hospital. Rescue work was immediately underway at the fire site as five fire trucks were used to extinguish the fire. People continued to signal for rescue by waving from windows on the upper floors. Due to cars being wrongly parked outside the plaza, rescue teams faced difficulties in their operation. There was an apparent lack of machinery required for the operation, according to Rescue 112 workers. Helicopters were used in the rescue operation to evacuate people from the building. The building was devoid of any fire exits. [96]

- A major fire that broke out at the **26-storey Mont Blanc building in South Mumbai (India) on December 14, 2013** evening, has left at least seven people dead. Four of the seven bodies are charred beyond recognition, fire officials say. It took fire engines three hours to douse the blaze. Five people were rescued from the 12th floor, where the fire started. The floor was completely gutted in the blaze. Six firefighters were also injured. Firefighters took 20 minutes to reach the fire spot. [97]
- **Jianye Mansion (Guangzhou, China, December 15, 2013)**: The fire engines' water only reached the building's tenth floor. A total of 58 fire engines and 350 firefighters were mobilized to extinguish the fire. [98]
- **Lacrosse Building, Australia (November 24, 2014)**: A fire ripped through Melbourne's 23-storey Lacrosse Building, which turned out to be covered in non-compliant combustible external cladding. Four hundred people were evacuated from the four-year-old building, with the city's fire brigade saying it was lucky nobody was killed. The cladding was blamed for the fire's rapid spread from the 8th floor to the top of the building. The building's owners have now launched a legal claim against the builders to cover the £10 million repair costs. [99]
- A fire broke out on the seventh floor of the **high-rise Shangri-la Hotel in downtown Ulaanbaatar (Mongolia, September 30, 2014)**. The building was under construction. Twenty-three people are believed to have been evacuated from the site. The blaze is understood to have started on the seventh floor of the building. [100]
- **July 18, 2014, Mumbai (India)**: A dozen firefighters were trapped for hours on the rooftop of a burning high-rise building after a fire they had put out started again. One firefighter died reportedly due to the smoke. A coast guard helicopter pulled out one of the men. The other firefighters climbed down to safety after the fire was doused again. About 30 firefighters visited Andheri's **22-story Lotus Business Park building**. The fire destroyed the first two floors before the personnel controlled it. People had been evacuated from the building. The fire personnel used the "top-down approach" as they went from floor to floor, fighting the blaze and rescuing people. A dozen firemen were left on the rooftop when the dying fire suddenly became stronger due to the winds. A helicopter was sent to rescue the personnel. The dramatic rescue of one firefighter was

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[96] https://tribune.com.pk/story/546486/several-trapped-as-fire-erupts-at-lda-plaza-in-lahore.
[97] https://www.ndtv.com/video/fire-in-26-storey-building-in-mumbai-kills-seven-301223.
[98] http://en.people.cn/90882/8485534.html.
[99] http://metro.co.uk/2017/06/19/australia-to-strip-buildings-of-flammable-cladding-after-grenfell-disaster-6719166/#ixzz4kSzT3qXW.
[100] https://www.independent.co.uk/news/world/asia/shangrila-hotel-mongolia-blaze-breaks-out-on-seventh-floor-of-building-9764097.html.

watched by a vast crowd below. The fire caused panic among the people working at the building. That made the evacuation process a little tricky. [101]

- **November 21, 2015**: A fire broke out on the 50th floor of the 100-story high-rise John Hancock Center (**Chicago, USA**). Five injuries were reported. [102]
- **Address Downtown Hotel, Dubai, UAE (2015)**: Civil Defense workers put out the New Year's Eve blaze that was accidental and originated from the exterior parts of the building on the 20th floor of the 63-floor building. At least 16 people sustained minor injuries and smoke inhalation in the blaze that broke out hours before the city's New Year's Eve fireworks event. [103]
- **Wisma Kosgoro building fire in Thamrin, Central Jakarta (Indonesia) on March 10, 2015**, was related to short-circuiting as a possible cause. The fire that ravaged the top floors of the building had been fully extinguished by firefighters after burning for hours. Thirty-five firefighters assisted in subduing the blaze, which roared through the building's 16th, 17th, 18th, 19th, and 20th floors. No fatalities were reported in the incident, and the Jakarta Police are still investigating the cause of the blaze. [104]
- **Residential Building, Baku, Azerbaijan**: 17 people were killed and more than 60 injured on **May 19, 2015**, in a fire that ripped through a 16-storey building in Azerbaijan's capital, Baku. As the fire consumed the 16-story Soviet-era high-rise, which had been renovated in recent years, a traffic jam formed as onlookers gathered on the surrounding streets. Gas canisters kept by the building's inhabitants began to explode. Eventually, more than 40 fire vehicles and ambulances were called to the scene. Two helicopters circled the top floor, though officials say they were "ineffective." Footage showed panicking residents begging the emergency staff to let them back inside the building, where their relatives remained trapped. [105]
- **Charles Street, Springburn, High-rise Flats, Glasgow (Scottland, UK, 2015)**: The blaze came just two years after improvement works that enclosed balconies to make the flats warmer. But locals feared external improvements to the tower block in Charles Street, Springburn, left it vulnerable to fire that spread through eight stores during the incident. [106]
- In **Odesa (Ukraine), on August 29, 2015**, a large-scale fire broke out in one of the high-rise buildings. One of the houses in the Gagarin Plaza residential complex is on fire. The fire spread to the entire height of the building. Firefighters do not have ladders high enough to reach the floors in flame. The wall cladding on the upper floors of the unfinished building complex caught fire. From the upper floors, the fire spread to the first floor. Firefighters can only reach the 7th floor. The fire is extinguished with the help of two high-altitude ladders of 30 and 50 meters. However, the problem is that the hoses do not have enough pressure, and the building does not have an internal fire extinguishing system. [107]

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[101] https://www.ndtv.com/mumbai-news/chopper-airlifts-fireman-from-burning-mumbai-high-rise-one-dead-590315.
[102] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[103] http://www.thenational.ae/uae/new-years-eve-blaze-at-the-address-downtown-dubai-put-out.
[104] https://www.thejakartapost.com/news/2015/03/10/wisma-kosgoro-fire-subdued-short-circuiting-possible-cause.html.
[105] https://www.rt.com/news/260125-azerbaijan-building-fire-fatal/.
[106] https://www.sundaypost.com/fp/scotlands-tragic-record-of-high-rise-fires-the-questions-raised-and-the-human-cost/.
[107] https://www.pravda.com.ua/news/2015/08/29/7079432/.

- **February 19, 2016**: A fire started on the 50th floor of Trump International Hotel & Tower (**Chicago, USA**). A sprinkler activated and contained the fire. No injuries, evacuations, or significant damage were reported. [108]
- **Shepherds Court, Shepherd's Bush, London (England, UK, 2016)**: In an 18-floor building, the fire started in a kitchen on the 7th floor and quickly spread up the exterior of the building. In response to a Freedom of Information Act (FOIA) request, the London Fire Brigade released research, dated November 30, 2016, into the white external insulation panels attached below the building windows. The report found that the panels comprised a 17-23 mm plywood board covered by blue polystyrene foam, mm steel sheet, and decorative white paint. When exposed to high flames, the polystyrene foam melted away, causing the metal sheet to fall and exposing the foam and wood to the fire. That is "likely" to have occurred to the panels above the flat where the fire started, with flaming droplets falling and flames spreading up. The experts concluded this is "likely to have assisted the fire in spreading up the outside of the building, as this mechanism progressively exposes a plywood surface to a developing fire. [109]
- **Sulafa Tower, Dubai (United Arab Emirates, July 20, 2016)**: The original cause of the fire in the residential building was a cigarette dropped by a resident on the 61st floor.
- On **January 19, 2017, the Plasco Building in Tehran (Iran)** caught fire. The 17-story mixed-use building was the first high-rise block in central Tehran. At least 20 firefighters were killed when the building caught fire and collapsed. Two hundred had battled the blaze in the landmark 17-story building for several hours before it fell to the ground in seconds. Another 70 people were injured, 23 of them seriously, in the incident. Completed in 1962, the building was once Tehran's tallest and contained a shopping center and clothing workshops. The cause of the fire is unknown, but fire safety issues can occur. [110]
- **Grenfell Tower, London (England, UK)**: The disastrous and unprecedented Grenfell Tower fire occurred on **June 14, 2017**, in a 24-floor building of public housing flats in North Kensington, West London. The tower block was designed in 1967 as part of phase one of the Lancaster West redevelopment project construction, which commenced in 1972, with the building being completed in 1974. The 67-metre-tall building contained 120 one- and two-bedroom flats (six dwellings per floor on twenty-four floors, with the other four used for non-residential purposes), housing up to 600 people. It was renovated in 2015–16, but, like many other high-rise buildings in the UK, the tower had only a single central staircase as UK regulations do not require a second staircase. The tower was designed with attention to strength following the collapse of the Ronan Point high-rise building in 1968. The fire started in the small hours of June 14, 2017. The London Fire Brigade was first called to a fridge fire, and the first responders arrived six minutes after the alarm. Firefighters put out the fridge fire within minutes, but by then, it had set the exterior of the building on fire, where it began to spread at a "terrifying rate." Residents alerted neighbors and began to evacuate the building. Due to Ramadan, many observing Muslim residents were awake for the pre-dawn meal of suhur, which enabled them to alert neighbors and help them escape. A team of 250 firefighters from 45 fire engines attempted to control the blaze. Firefighters entered

[108] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[109] http://www.insidehousing.co.uk/a-stark-warning-the-shepherds-bush-tower-block-fire/7019879.article.
[110] https://www.bbc.com/news/world-middle-east-38675628.

the building to rescue people, undertaking efforts that broke their safety protocols but reported the extreme heat hindered them. At the height of the blaze, a hundred or more firefighters were inside the building. The fire on the exterior moved upward and to the other side, re-entering the building. Fire crews with breathing apparatus searched for people trapped in the building and carried them out; they reported thick smoke and zero visibility above the fourth floor. After three hours, the original teams of firefighters were replaced by new crews. London Fire Brigade reported firefighters rescued 65 people from the building and reached all 24 floors. [111]

- **December 30, 2017**: Three people were treated for smoke inhalation, and one man was taken to hospital after a fire broke out at the Lighthouse Apartments in Manchester's Northern Quarter. It started on the ninth floor of the 12-storey block and climbed up the 10th and 11th floors via wooden balconies. [112]
- **February 18, 2018**: A fire broke out on the 52nd floor of the formerly named John Hancock Center (**Chicago, USA**). The fire started in the kitchen area of a studio apartment. Firefighters rescued the tenant, who was listed in serious condition. The fire was contained to one unit. There are no fire sprinklers in the building's residential units between the 44th and 92nd floors. [113]

- The fire broke out on **September 5, 2018, in the Bank of Lisbon in the Johannesburg city center (South Africa), killing three firefighters** and leaving many injured. The fire raged for three days as the struggling city's fire department called upon the Tshwane and Ekurhuleni metros to assist in putting out the fire. The building was a 101-metre-high building, 23 floors high, that housed different public authorities. Later, the building was demolished. [114] [115]
- The office building in **São Paulo (Brazil)** has been unused since 2015. There were no new tenants in sight. With the length of the process and the lack of interest in the purchase, the building was invaded by poor and homeless people. At dawn on **May 1, 2018**, a **fire caused the collapse of Wilton Paes de Almeida's building**. The fire started around 1:30 AM, and the flames began with a probable short circuit on the fifth floor. In a short time, due to the building's constructive characteristics, the fire spread quickly through the other floors, both upwards (as expected) and downwards (unexpected), taking over the entire structure from the ground floor to the roof. At about 2:50 AM, the building as a whole, still in flames, collapsed on itself, causing the death of seven people and much damage to the neighboring buildings as well as a massive disruption to families and the traffic and free movement of people from the region. [116]
- The death toll from a **horrific blaze that ripped through a Dhaka (Bangladesh) high-rise building on Thursday, March 28, 2019, has climbed to 25**. The blaze left hundreds of people trapped inside the 23-story tower, screaming for help as horrified onlookers massed outside. Some of those stuck inside made it to safety by sliding down cables on the side of the building, but others took their chances and jumped in a bid to escape the smoke and heat. Several leaped to their deaths. More than 70 people were treated at the hospital. Officials said there were no sprinklers, and fire exits

[111] https://en.wikipedia.org/wiki/Grenfell_Tower_fire - Construction.
[112] https://www.insidehousing.co.uk/insight/warning-signs-a-timeline-of-major-residential-fires-post-grenfell-64191.
[113] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[114] https://www.iol.co.za/news/south-africa/cause-of-lisbon-bank-blaze-remains-a-mystery-a-month-after-tragedy-17425635.
[115] https://www.iol.co.za/news/south-africa/gauteng/we-have-informed-families-about-bank-of-lisbon-demolition-says-joburg-ems-37773971.
[116] https://www.redalyc.org/jatsRepo/4276/427661546009/html/index.html.

existed only in name. At just 0.6 and 1.2 meters wide, the building's two exits were too narrow for people inside to leave smoothly and were blocked by obstructions that made the task harder. It was investigating how the owner, who had permission only to build 18 stories, managed to extend the building to 22 stories. [117]

- At least two people died, and 17 others were injured, some after jumping from the eighth floor, when the fire broke out at the **Central World Shopping Complex in Bangkok (Thailand) on the evening of April 10, 2019**. Witnesses saw two people jumping from the eighth floor. Thick black smoke was seen billowing out, and explosions were heard. Both the hotel and the shopping center were evacuated. Initial reports said many people were trapped in the building. The firefighters put out the blaze at 6:10 PM, about half an hour after it started. The fire started in a document room on the eighth floor. The **whole 16-story building was ordered closed**, pending an investigation into the cause of the fire and the effectiveness of its fire suppression system. The deceased were reportedly staff at the shopping complex. The 17 injured people were admitted to two hospitals for smoke inhalation. The blaze caused heavy traffic snarl-ups in the vicinity in the evening rush hour. [118]
- **The Warsaw Hub (Poland, 2019)** is a 31-story reinforced concrete building under construction when its upper floors caught fire. It was previously known as Sienna Towers. Although the area around the Warsaw Hub was closed to the public as a safety precaution, the fire brigade said the fire did not damage the structural integrity of the building, which was in no danger of collapse. [119]
- Five people died in the early morning of **November 27, 2019, in a fire on the 14th floor of a Minneapolis** (**Minnesota, USA)** public housing high rise, with three others hospitalized. The blaze broke out around 4:00 AM in the 25-story Cedar High Apartments near downtown Minneapolis. It was extinguished within 30 minutes. The alarm company that monitors the building alerted the Fire Department, and crews arrived to find flames shooting out of windows on the 14th floor. They encountered heavy smoke as they got to the floor, searching for residents. The 191-unit building for low-income clients is at full capacity. Most units have either one or two adult residents. Many of them are of Somali descent, with fewer Korean backgrounds. The building has smoke alarms, but the building code does not require a structure of that age to have a sprinkler system. Windows for one 14th-floor apartment were broken out, and the walls were visibly charred. Firefighters said they frequently respond to false alarms at this address. One said fighting a fire in this high-rise is challenging because of its small, confined spaces. They also must confront language barriers when communicating with residents, many of whom are elderly. [120]
- A fire on **July 13, 2020**, damaged a **World Trade Center** building section in the Federal Capital Territory, **Abuja (Nigeria).** An eyewitness said that the **fire started from the top of the skyscraper** that dots the skyline of Central Business District, Abuja, as smoke billowed from the pinnacle. First responders, including firefighters, have since been drafted to the incident scene. High-pressure sprinklers in the building had extinguished the fire. There was a minor fire outbreak on one of the floors near the top floor near the shaft. The building is high-tech, and sprinklers are used to

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[117] https://www.ctbuh.org/news/deadly-blaze-engulfs-high-rise-building-in-dhaka.
[118] https://www.ctbuh.org/news/deadly-fire-breaks-out-at-vertical-mall-in-bangkok.
[119] https://www.ctbuh.org/news/massive-blaze-engulfs-under-construction-skyscraper-in-warsaw/.
[120] https://www.ctbuh.org/news/blaze-in-minneapolis-high-rise-results-in-casualties.

extinguish the fire. Because the fire occurred close to the top floor and the extraction system was on the roof, smoke came out even after the fire had been extinguished. [121]

- **August 9, 2020, Bohumin, Czech Republic**: In the early evening, firefighters intervened in a tragic fire on the 11th floor of a 13-story high-rise apartment building. The fire quickly engulfed one of the apartments, claimed a total of 11 lives, and injured several people. Eleven people, including three children, have died. It was stated that the fire was intentionally started, and one person has been arrested. The fire started on the eleventh floor of an apartment building. People jumped from the windows of the 13-story building during the fire. Five of the dead died when they jumped from the twelfth floor in a panic. In addition to the eleven dead, at least ten people were injured. Two firefighters were injured. The fire spread unusually fast, supporting the suspicion that the fire was intentionally started. [122]
- **September 15, 2020**: 400 E. Randolph in **Chicago (USA)**. The fire broke out on the 32nd floor. 6 people were injured, and one pet died. [123]
- A fire spread up a **high-rise apartment building by strong winds in the South Korean port city of Ulsan** left scores of people with minor injuries **on October 8, 2020**. Footage from the scene in Ulsan showed a massive ball of orange flame soaring up the 33-floor building and shooting through the roof as firefighting crews tried to put out the blaze from below. There were no immediate reports of deaths or serious injuries. Hundreds of residents evacuated as the fire broke out while workers rescued another 77 who had escaped to the roof or other spaces. At least 88 people were treated for minor injuries such as scratches or lightly inhaling smoke. Officials are investigating the cause of the fire, which they said started at a balcony in one of the lower, and spread up the exterior of the building amid strong winds. [124]
- A fire broke out on the top floor of **a high-rise building in Makati City (Philippines) on April 6, 2021**. The blaze occurred on the 14th floor at Verdina IV, a commercial building along LP Leviste Street at Salcedo Village. The hour-long fire reached the first alarm at 2:52 PM, a second alarm at 3 PM, was placed under control at 3:30 PM and extinguished at 3:48 PM. The fire did not spread to other floors. No fatality or injury was reported. The cause of the fire has yet to be determined. [125]
- A **high-rise fire in Chicago on January 25, 2023**, killed one resident and sent eight others to the hospital. The building has many elderly residents, and many of the building's residents have suffered displacement due to fire and water damage. According to officials, the fire was a challenge to extinguish due to high winds and the fire climbing vertically relatively quickly. There was one fatality on the 15th floor, where the fire is believed to have originated. Eight other residents suffered non-life-threatening injuries. One firefighter was also transported for a non-life-threatening injury. All other residents of the building are safe. Due to the layout of the building, residents not near the floors impacted were instructed to shelter in place. [126]

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[121] https://www.ctbuh.org/news/fire-breaks-out-at-the-world-trade-center-in-abuja.
[122] https://ctif.org/news/high-rise-fire-czech-republic-claimed-11-lives-and-injured-two-firefighters.
[123] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[124] https://www.ctbuh.org/news/at-least-88-hurt-in-ulsan-high-rise-fire.
[125] https://www.ctbuh.org/news/fire-hits-high-rise-building-in-makati.
[126] https://www.ctbuh.org/news/multiple-hospitalized-and-one-fatality-in-kenwood-high-rise-fire-in-chicago.

- On **September 12, 2023**, a fire occurred in a nine-story apartment building in the Thanh Xuan district, **Hanoi (Vietnam)**. Of the approximately 150 people residing in the building, the fire killed 56, and 37 others were injured. Due to the design of the mini apartment, there is only one staircase and all hot smoke and toxic gas are rising, causing the majority of victims to die on the way to the top floor. [127] [128]
- **February 21, 2024:** 7144 S. Jeffery Boulevard (**Chicago, USA**). The fire broke out in a kitchen on the 2nd floor of the 14-story building; 8 persons were injured, including one infant in critical condition. [129]
- A large fire broke out in a reported 28-story **high-rise under construction** in the Torre neighborhood of **Recife in Brazil on March 28, 2024**. Firefighters were battling a sizable structure fire. Several reports of debris falling into the streets were made. As a precaution, the authorities shut off the electricity and evacuated a number of the nearby buildings. No casualties have been reported, and no statement has been made about what started the fire. [130]
- **10. Apr. 2024**: A fire in a large, primarily **residential building, "The New Lucky House" in Hong Kong (China)**, killed at least five people and left another 36 injured. The fire began on the first and second floors of the 16-story building, where a gym and licensed guest rooms were. [131]

Table 3.1: Number of fires by annual intervals and continents.

Years	Africa	Asia	Europe	North America	Middle, South America	Oceania	Sum	%
1911-1984	0	0	1	5	1	0	**7**	**6.2**
1985-1989	1	0	0	5	2	0	**8**	**7.1**
1990-1994	0	0	3	1	0	0	**4**	**3.5**
1995-1999	0	5	4	2	0	0	**11**	**9.7**
2000-2004	3	1	3	6	1	0	**14**	**12.4**
2005-2009	0	4	8	1	0	0	**13**	**11.5**
2010-2014	0	13	12	1	1	1	**28**	**24.8**
2015-2019	1	7	6	4	1	0	**19**	**16.8**
2020-2024	0	4	1	3	1	0	**9**	**8.0**
Sum	**5**	**34**	**38**	**28**	**7**	**1**	**113**	**100.0**
%	**4,4**	**30.1**	**33.6**	**24.8**	**6.2**	**0.9**	**100.0**	

[127] https://www.bbc.com/news/world-asia-66794751.
[128] https://video.vnexpress.net/tin-tuc/thoi-su/canh-sat-cuu-hoa-cau-thang-bo-vi-tri-tu-than-trong-chung-cu-chay-4653639.html.
[129] https://highriselifesafety.com/history-of-chicago-high-rise-fires-and-codes/.
[130] https://www.ctbuh.org/news/under-construction-high-rise-in-recife-catches-fire.
[131] https://sg.news.yahoo.com/hong-kong-building-fire-kills-025746727.html.

The above list covers 1911 to 2024 (Table 3.1). The individual fires recorded were subject to the coincidence that the list is in no case complete or exhaustive. The fires are distributed by year among 38 countries in alphabetical order: Australia, Azerbaijan, Bangladesh, Brazil, Canada, China, Czech Republic, Egypt, France, Greece, India, Indonesia, Iran, Italy, Japan, Kazakhstan, Saudi Arabia, Malaysia, Mexico, Mongolia, Nederland's, Nigeria, Pakistan, Philippines, Poland, Puerto Rico, Russia, South Africa, South Korea, Spain, Thailand, Türkiye, UAE, UK, Ukraine, USA, Venezuela, and Vietnam. Among all countries, the following top should be mentioned: UAE (5 fires, 4,4%), China (8 fires, 7,1%), Russia (8 fires, 7,1%), UK (21 fires, 18,6%), and the USA (26 fires, 23%).

Looking at the **buildings examined according to their type of use** at the respective date of the fire outbreak, the following overview of the top 5 can be presented: buildings under construction (4, 3.5%), commercial buildings (8, 7.1%), hotels (9, 8.0%), office-residential buildings (14, 12.4%), and residential buildings (48, 42.5%). The main type of use of 18 buildings (15.9%) could not be determined.

The following statements about the number of **victims** are in the table (Table 3.2).
In 46% of all cases, no statements can be made about deaths, and in 58.4% of the statements about people injured in high-rise fires, no casualties were reported in 13.3% of all fires (8.8%). That also applies to 8.8% of injured persons. 1-5 fire deaths per fire occurred in 17.7% of all cases investigated. With 8.8% injured, the interval of 51-100 people is clearly at the top (Table 3.2).

Table 3.2: Number of victims of high-rise fires.

Number of persons per fire	Number of cases			
	Deaths	%	Injuries	%
1 bis 5	20	17.7	3	2.7
6 bis 10	7	6.2	6	5.3
11 bis 15	3	2.7	4	3.5
16 bis 20	3	2.7	3	2.7
21 bis 25	1	0.9	0	0.0
26 bis 30	0	0.0	1	0.9
31 bis 50	3	2.7	5	4.4
51 bis 100	6	5.3	10	8.8
more than 100	3	2.7	5	4.4
Sum	**46**	**40.7**	**37**	**32.7**
Without victims	15	13.3	10	8.8
Not specified	52	46.0	66	58.4
Total	**113**	**100.0**	**113**	**100.0**

The question of the **causes of the fire** arouses further interest. Figure 3.1 provides an overview of this. Unfortunately, no information is available from the case studies described above for almost 78% of the cases. However, it can be assumed that at least every 10th fire was caused by electricity.

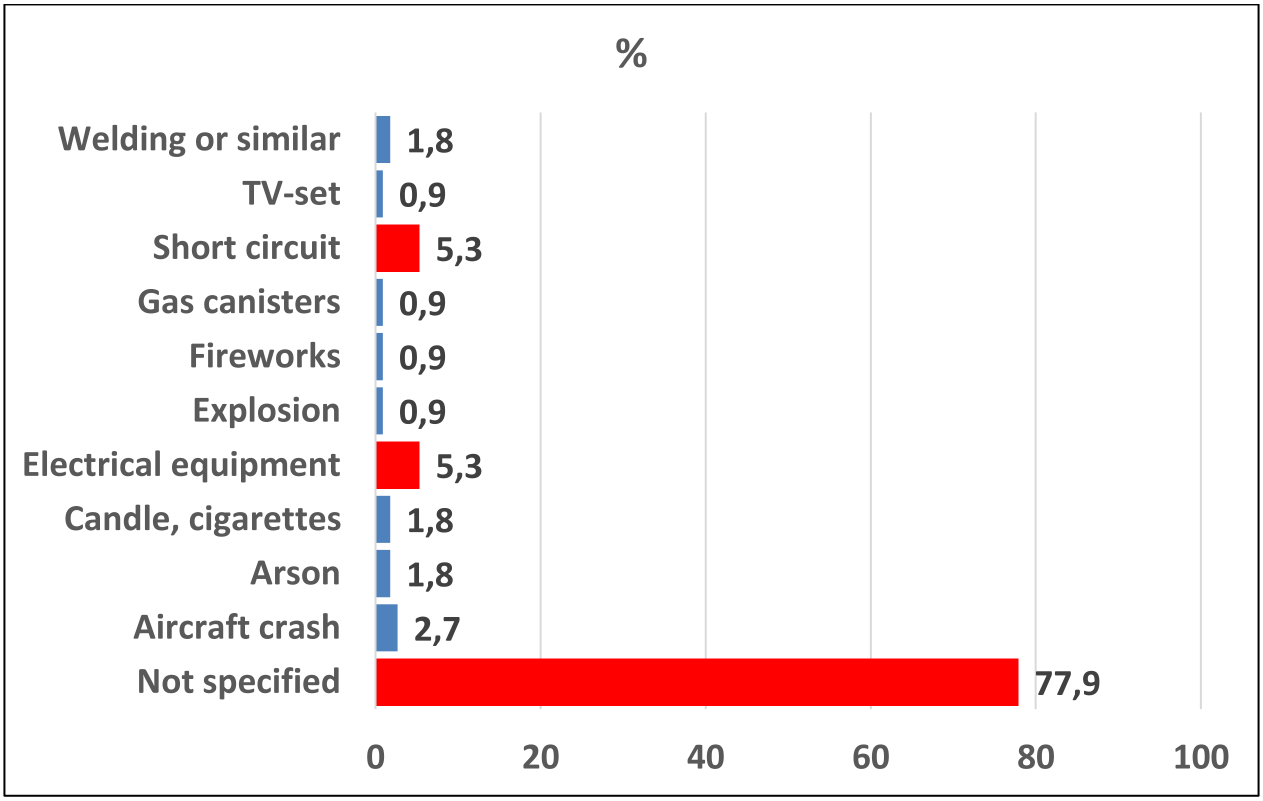


Figure 3.1: Fire causes in 113 selected high-rise fires.

Let us now ask **which floor of the high-rise building the fire broke out** on. Unfortunately, the data situation does not show any tendency. We can only note that no information is available in 50% of all the cases examined here. If information has been provided, values from "First floor" to "74th floor" can be determined. All known figures are clearly in the single-digit percentage range. We also investigated **how many floors were affected by the fire**. In 79.6% of all fires examined, no data is available. In the remaining cases, the statements are in the interval from "2 floors" to "all floors." The type of naming is also very different: For example – "2 floors", "5 floors", or "9 floors" means it is not clear where exactly in the building. In addition, there are also indications such as "Floors 12-16" or "Floors 26-28".

It is tough to assess the **condition of the high-rise building at the time of the fire**. We use selected text passages to gather essential and eye-catching information from our point of view.

As already stated in the literature review at the beginning, the question of the **existence of a sprinkler system** is of outstanding importance. We were able to take the following text passages from the case studies:

- the fire protection system was turned off,
- no automatic sprinkler system,
- no fire sprinklers in the building's residential units between the 44th and 92 floors,
- no sprinklers / non-sprinkled building.

There are also individual statements on the question of the **functionality of the sprinkler system**:

- Sprinkler activated,
- Sprinklers – worked!
- The building's fire-extinguishing system automatically activated.
- The fire was only controlled when it reached one floor that was protected by automatic sprinklers.
- Sprinklers failed because they were clogged or were not connected to the piping system.

Another big problem is the **stairs**:

- Fire exits existed only in name,
- Only one staircase,
- Problems with stairs.

Another question is whether the building is divided into **vertical and horizontal sections**, which limit the spread of smoke and flames in the event of a fire:

- No compartmentalization.

Without further comment, the following remarks should then be considered. If one looks at the entire overview regarding whether these were **façade fires**, the following statement emerges: There are no direct indications for 96 cases of fire (85%). However, in 17 fires (15%), there are more or less clear indications that the fire has spread over the building façade.

Now, let's turn to the **operational items**:

- Closed standpipe riser valves and a damaged fire hydrant,
- Firefighting with water, but the problem is that there is not enough pressure in the hoses, and the building itself does not have an internal fire extinguishing system,
- Firefighters had trouble dealing with the fire because their fire engines shot water up only 50 m, while the building was 220 m tall,
- Water from the fire engines only reached the tenth floor of the building,
- Insufficient water pressure from the building's standpipes,
- It took the fire service at least one and a half hours to set up a (water) pump and hoses on the 25th floor to finally combat the fire effectively,
- Late notification of the fire,
- Firefighters took 21 minutes to reach the fire spot,
- Wrongly parked cars outside the building, lack of required machinery for the operation,
- Firefighters with radio communication problems,
- As a precaution, the authorities shut off the electricity and evacuated a number of the nearby buildings.
- Problems with stairs (too narrow, too few, people from top to bottom, firefighters from bottom to top),
- Fire brigade turntable ladder – only 11 floors.
- The fire is extinguished with the help of two high-altitude ladders of 31 and 51 meters,
- Helicopters circled the top floor, though officials say they were “ineffective.”

- Some persons were rescued by helicopters,
- Helicopters were used.

The following illustration visualizes a basic question regarding rescuing people and extinguishing a fire in high-rise buildings, whereby we are not targeting super-tall buildings but rather high-rise buildings where the use of standardized turntable ladders can play a role (Figure 3.2).

❶ shows the often-optimal situation: the turntable ladder of the fire brigade can drive relatively close to the building. The existing surfaces allow the positioning of the rescue device from the surface and the ground load. There are no significant obstacles to reach the balcony of the 7-8th floor ❷. Which floor can finally be reached by the turntable ladder will then continue to depend on the height of all floors. Especially in the case of mixed use of the high-rise buildings, the floor heights can differ considerably. If turntable ladders with a rescue height of 50 or even 64m are used, the need for installation space and load on the road increases. [132] [133]

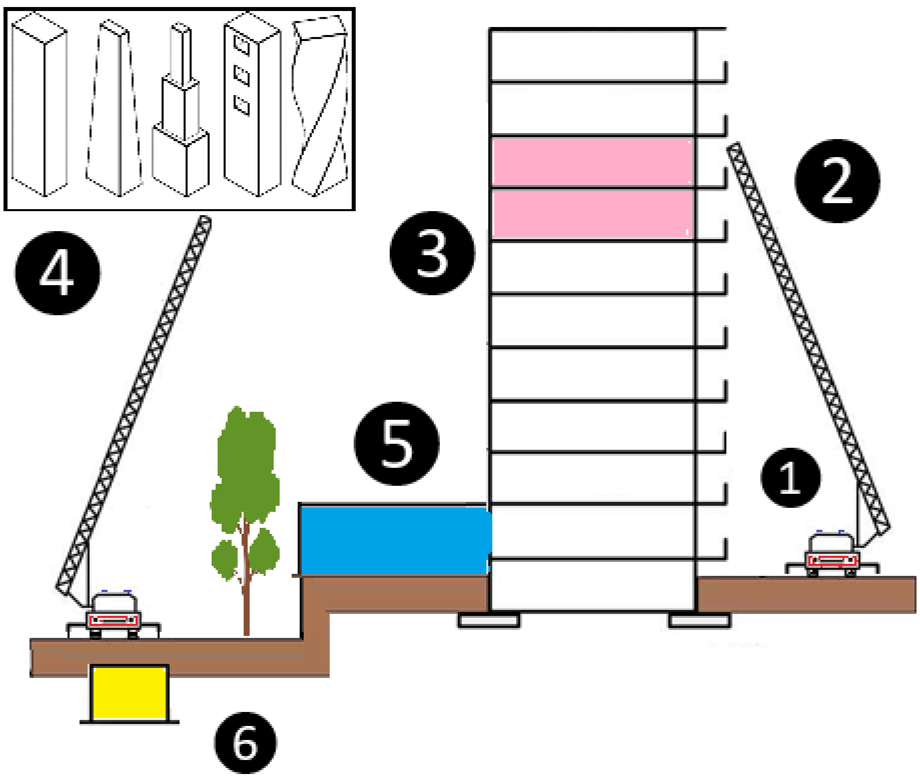


Figure 3.2: Basic questions regarding rescuing people and extinguishing a fire in high-rise buildings.

❸ It is a small illusion to assume that a rectangular high-rise building on each side of the building provides the same conditions for the work of the fire brigade (rescuing people, extinguishing the fire). Balconies and openable windows do not exist on all facades. As the building height increases, the conditions change. Climatic conditions (extreme cold in winter, high temperatures in the warm seasons and the wind load on

[132] https://www.brusselstimes.com/605555/brussels-fire-brigade-present-tallest-ladder-truck-in-europe.
[133] https://www.london-fire.gov.uk/news/2021-news/november/london-fire-brigade-to-bring-in-uk-s-tallest-aerial-ladder-into-operational-use/.

the façade) are of particular local importance. If high-rise buildings are of manageable height, the façade is usually uniformly designed. In buildings with a higher number of floors, the extravagance of the building facades increases considerably ❹.

In some of the internationally known fire cases, surprising peculiarities were revealed. Extensions were subsequently built. Although these parts of the building improve the conditions of use of the high-rise building (shopping, bars, restaurants, etc.), they have a negative effect on the possibilities of the fire brigades ❺.

Finally, we turn our attention to three more important moments. It is not uncommon for the height of the road to vary ❻ (compare ❶). In some cases, there are ducts for pipelines or even subway shafts below the street. This can lead to problems. After completion of the construction work, the horticultural design of the site will come into play. At first, the trees are small.

Resumé:

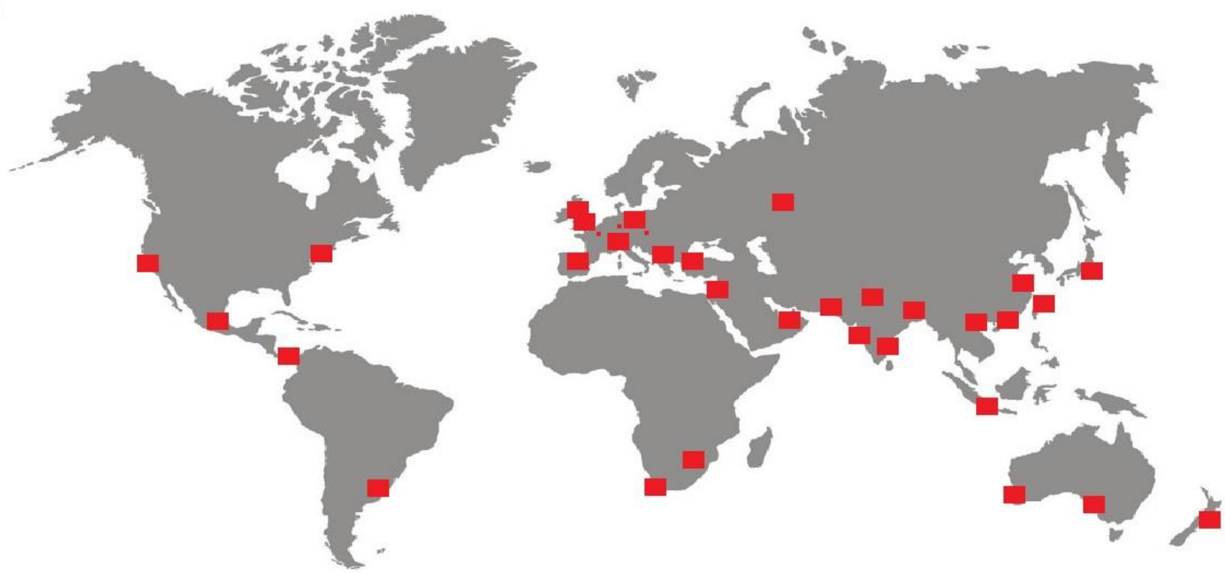
1. The information on the 113 high-rise fires examined here comes from reports, specialist articles, and, in the majority, local, national, and international press releases.
2. The structure and the extent of the averaging vary greatly. Depending on the message, the technical terms used also vary.
3. The number of cases from the countries under consideration varies, presumably due to the compilation of the case studies.
4. A clean statistical evaluation of the high-rise fires is not possible. Nevertheless, the compilation presented here is of value. The textual representations convey a sufficient closeness to reality. The sources cited are for further research.
5. The case studies show that high-rise fires are a current fire protection problem across national borders.
6. High-rise fires are not only limited to one type of use but are a general problem.
7. Casualties are to be lamented in many high-rise fires: dead, injured, homeless.
8. The causes of fires in high-rise buildings are obviously similar to those in other buildings: electricity, smoking, arson, construction work, and technical accidents.
9. If a comparatively small database exists, it is impossible to determine which floor fires break out and how many floors are affected by the fire.
10. Adequate fire protection in high-rise buildings undoubtedly depends on the level of preventive measures. This applies to the work of architects, construction companies, companies that equip the interior and exterior of the building with materials and equipment, the building's administration, and, ultimately, the users and residents. However, fire prevention must cover at least 95% of all risks!
11. The importance of a functioning sprinkler system, a well-designed staircase system, and uncompromising compartmentalization is beyond doubt. There can be no compromises on this.
12. Fighting a fire in a high-rise building may only have a 5% residual risk. Effective preventive measures must cover 95% of all risks.
13. In order to rescue people from a burning high-rise building, the local fire brigade must ensure that the building has sufficient stairs (number and dimensions), a sprinkler system that works on all floors, technically safe elevators (including safety gates with positive-pressure ventilation), and an effective vertical and horizontal subdivision.
14. Standpipes, riser, and fire hydrants are in proper condition.
15. Placement of fire vehicles must be good, especially for fire turntable ladders and hydraulically platform vehicles.
16. High-rise buildings must have an internal radio communication system for rescue services.

4.0 High-rise Buildings by Use

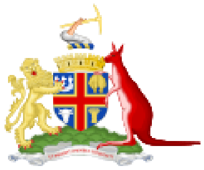
In this section, we summarize information about high-rise buildings in selected cities. It should be noted that the sources used almost without exception refer to the respective tallest buildings in the town. The availability of the following information always accompanies the selection of the respective buildings:

- **City**: since high-rise buildings are more the hallmark of urban construction, the names of the towns are given; therefore, rural areas have not been considered.
- **Name of the building**: Assigning a name to the high-rise is customary.
- **Height, m**: the indication of the building height helps to divide the high-rise buildings into groups.
- **Floors**: the specification of the floors helps to divide the high-rise buildings into groups, especially since garages can often be arranged on the lowest floors.
- **Use**: The type of use of the high-rise building is particularly interesting. Information suggests that the building is subject to only one type of use, but mixed types of use are also known.
- **Year**: when a building was erected and handed over for use is of general interest.

The cities have been selected based on all the above information and arranged alphabetically in the sections below.



4.01 Adelaide (Australia)



Founded in 1836, the city is home to about 1,368,000 inhabitants in 2021 on an area of 3,259.8 km². This results in a population density of 420 inhabitants per km². A list of 50 high-rise buildings is available. The buildings were handed over to their intended purpose between 1966 and 2025. The high-rise buildings have a height of between 65 m and 135 m. The buildings count between 14 and 40 floors. Other high-rise buildings are indeed located in the city, but outside the intervals just described.

The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.01-1) shows that 78% of the buildings are located in the interval of 51 to 100 m. In the Top 3, commercial buildings, residential buildings, and hotels can be found.

Table 4.01-1: Distribution of high-rise buildings by type of use and building height in Adelaide (Australia).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial office	0.0	34.0	8.0	0.0	0.0	**42.0**
Commercial office/ shopping center	0.0	4.0	0.0	0.0	0.0	**4.0**
Government office	0.0	6.0	0.0	0.0	0.0	**6.0**
Hotel	0.0	10.0	0.0	0.0	0.0	**10.0**
Mixed use	0.0	0.0	2.0	0.0	0.0	**2.0**
Mixed use, including hotel	0.0	0.0	2.0	0.0	0.0	**2.0**
Residential	0.0	18.0	6.0	0.0	0.0	**24.0**
Student accommodation	0.0	0.0	4.0	0.0	0.0	**4.0**
Telephone exchange	0.0	2.0	0.0	0.0	0.0	**2.0**
University	0.0	4.0	0.0	0.0	0.0	**4.0**
Sum, %	**0.0**	**78.0**	**22.0**	**0.0**	**0.0**	**100.0**

Table 4.01-2: Distribution of high-rise buildings by type of use and number of floors in Adelaide (Australia).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial office	0.0	24.0	16.0	2.0	0.0	**42.0**
Commercial office/ shopping center	0.0	4.0	0.0	0.0	0.0	**4.0**
Government office	0.0	6.0	0.0	0.0	0.0	**6.0**
Hotel	0.0	2.0	8.0	0.0	0.0	**10.0**
Mixed use	0.0	0.0	0.0	2.0	0.0	**2.0**
Mixed use, including hotel	0.0	0.0	0.0	2.0	0.0	**2.0**
Residential	0.0	4.0	16.0	4.0	0.0	**24.0**
Student accommodation	0.0	0.0	0.0	4.0	0.0	**4.0**
Telephone exchange	0.0	2.0	0.0	0.0	0.0	**2.0**
University	0.0	4.0	0.0	0.0	0.0	**4.0**
Sum, %	**0.0**	**42.0**	**40.0**	**14.0**	**0.0**	**100.0**

Table 4.01-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 82% of all buildings have 11 to 30 floors. These are mainly commercial offices or residential buildings.

4.02 Amman (Jordan)

The city is home to about 4,834,500 inhabitants in 2023 on an area of 1,680 km². This results in a population density of 2,877 inhabitants per km². A list of 24 high-rise buildings is available. The buildings were handed over to their intended purpose between 1979 and 2018. The high-rise buildings have a height of between 65 m and 188 m. The buildings count between 12 and 50 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.02-1) shows that 91% of the buildings are located in the interval of 51 to 150 m. In the Top two, hotel and office buildings can be found.

Table 4.02-1: Distribution of high-rise buildings by type of use and building height in Amman (Jordan).

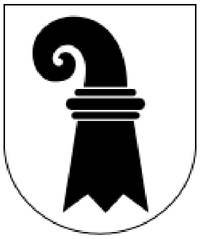
Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	29.2	8.3	4.2	0.0	**41.7**
Medical	0.0	4.2	4.2	0.0	0.0	**8.3**
Offices	0.0	37.5	0.0	0.0	0.0	**37.5**
Residential	0.0	4.2	4.2	0.0	0.0	**8.3**
Residential, Hotel	0.0	0.0	0.0	4.2	0.0	**4.2**
Sum, %	**0.0**	**75.0**	**16.7**	**8.3**	**0.0**	**100.0**

Table 4.02-2: Distribution of high-rise buildings by type of use and number of floors in Amman (Jordan).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	29.2	0.0	12.5	0.0	**41.7**
Medical	0.0	4.2	0.0	4.2	0.0	**8.3**
Offices	0.0	25.0	12.5	0.0	0.0	**37.5**
Residential	0.0	0.0	4.2	4.2	0.0	**8.3**
Residential, Hotel	0.0	0.0	0.0	4.2	0.0	**4.2**
Sum, %	**0.0**	**58.3**	**16.7**	**25.0**	**0.0**	**100.0**

Table 4.02-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 58% of all buildings have 11 to 30 floors. These are mainly hotels and commercial offices.

4.03 Basel (Switzerland)



The city is home to about 176,000 inhabitants in 2023 on an area of 23.85 km². This results in a population density of 7,393 inhabitants per km². A list of 39 high-rise buildings is available. The buildings were handed over to their intended purpose between 1960 and 2023. The high-rise buildings have a height of between 51 m and 205 m. The buildings count between 12 and 50 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.03-1) shows that nearly 90% of the buildings are located in the interval of 51 to 100 m. In the Top two, office and residential buildings can be found.

Table 4.03-1: Distribution of high-rise buildings by type of use and building height in Basel (Switzerland).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Educational Facility	0.0	2.6	0.0	0.0	0.0	**2.6**
Hotel, Offices	0.0	2.6	0.0	0.0	0.0	**2.6**
Hotel, Offices, Club	0.0	0.0	2.6	0.0	0.0	**2.6**
Laboratory, Research Center	0.0	2.6	2.6	0.0	0.0	**5.1**
Offices	0.0	41.0	0.0	2.6	2.6	**46.2**
Offices, Residential	0.0	5.1	0.0	0.0	0.0	**5.1**
Offices, Restaurant	0.0	2.6	0.0	0.0	0.0	**2.6**
Residential	0.0	33.3	0.0	0.0	0.0	**33.3**
Sum, %	**0.0**	**89.7**	**5.1**	**2.6**	**2.6**	**100.0**

Table 4.03-2: Distribution of high-rise buildings by type of use and number of floors in Basel (Switzerland).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Educational Facility	0.0	2.6	0.0	0.0	0.0	**2.6**
Hotel, Offices	0.0	0.0	2.6	0.0	0.0	**2.6**
Hotel, Offices, Club	0.0	0.0	0.0	2.6	0.0	**2.6**
Laboratory, Research center	0.0	2.6	2.6	0.0	0.0	**5.1**
Offices	7.7	30.8	2.6	5.1	0.0	**46.2**
Offices, Residential	0.0	5.1	0.0	0.0	0.0	**5.1**
Offices, Restaurant	0.0	2.6	0.0	0.0	0.0	**2.6**
Residential	0.0	30.8	2.6	0.0	0.0	**33.3**
Sum, %	**7.7**	**74.4**	**10.3**	**7.7**	**0.0**	**100.0**

Table 4.03-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 74% of all buildings have 10 to 20 floors. These are mainly office buildings and residential buildings.

4.04 Berlin (Germany)

The city was founded in 1237 and is home to about 3,662,381 inhabitants in 2023 on an area of 891.1 km². This results in a population density of 4,110 inhabitants per km². A list of 205 high-rise buildings is available. The buildings were handed over to their intended purpose between 1910 and 2023. The high-rise buildings have a height of between 42 m and 142 m. The buildings count between 10 and 36 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.04-1) shows that 92% of the buildings are located in the interval of 51 to 100 m. The top 2 residential buildings and office buildings can be found.

Table 4.04-1: Distribution of high-rise buildings by type of use and building height in Berlin (Germany).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Residential	1.5	62.4	0.5	0.0	0.0	**64.4**
Factory	0.5	0.5	0.0	0.0	0.0	**1.0**
Hospital	0.0	0.5	0.0	0.0	0.0	**0.5**
Hotel	0.5	3.4	0.5	0.0	0.0	**4.4**
Office	1.5	15.6	2.0	0.0	0.0	**19.0**
Office-Hotel	0.0	1.0	0.0	0.0	0.0	**1.0**
Office-Trade	0.0	0.0	0.5	0.0	0.0	**0.5**
Other	0.0	0.5	0.0	0.0	0.0	**0.5**
Trade, Service, Apartment	0.0	8.3	0.5	0.0	0.0	**8.8**
Sum, %	**3.9**	**92.2**	**3.9**	**0.0**	**0.0**	**100.0**

Table 4.04-2: Distribution of high-rise buildings by type of use and number of floors in Berlin (Germany).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Residential	0.0	40.0	23.9	0.5	0.0	**64.4**
Factory	0.5	0.5	0.0	0.0	0.0	**1.0**
Hospital	0.0	0.0	0.5	0.0	0.0	**0.5**
Hotel	0.5	3.4	0.0	0.5	0.0	**4.4**
Office	0.5	11.7	5.9	1.0	0.0	**19.0**
Office, Hotel	0.0	1.0	0.0	0.0	0.0	**1.0**
Office, Trade	0.0	0.0	0.5	0.0	0.0	**0.5**
Other	0.0	0.5	0.0	0.0	0.0	**0.5**
Trade, Service, residential	0.0	2.9	5.9	0.0	0.0	**8.8**
Sum, %	**1.5**	**60.0**	**36.6**	**2.0**	**0.0**	**100.0**

Table 4.04-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 96% of all buildings have 11 to 30 floors. These are mainly residential buildings and office buildings.

4.05 Buenos Aires (Argentina)

The town was founded in 1536/1580; the city is home to about 3,121,707 inhabitants in 2022 on an area of 205.9 km². This results in a population density of 15,161 inhabitants per km². A list of 82 high-rise buildings is available. The buildings were handed over to their intended purpose between 1936 and 2019. The high-rise buildings have a height of between 87 m and 235 m. The buildings count between 19 and 55 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.05-1) shows that 76% of the buildings are located in the interval of 101 to 150 m. In the Top two, residential and office buildings can be found.

Table 4.05-1: Distribution of high-rise buildings by type of use and building height in Buenos Aires (Argentina).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Education	0.0	1.2	0.0	0.0	0.0	**1.2**
Office	0.0	0.0	25.6	2.4	0.0	**28.0**
Residential	0.0	9.8	48.8	9.8	1.2	**69.5**
Residential / Hotel	0.0	0.0	1.2	0.0	0.0	**1.2**
Sum, %	**0.0**	**11.0**	**75.6**	**12.2**	**1.2**	**100.0**

Table 4.05-2: Distribution of high-rise buildings by type of use and number of floors in Buenos Aires (Argentina).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Education	0.0	1.2	0.0	0.0	0.0	**1.2**
Office	0.0	0.0	18.3	9.8	0.0	**28.0**
Residential	0.0	0.0	7.3	58.5	3.7	**69.5**
Residential / Hotel	0.0	0.0	0.0	1.2	0.0	**1.2**
Sum, %	**0.0**	**1.2**	**25.6**	**69.5**	**3.7**	**100.0**

Table 4.05-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 69% of all buildings have 31 to 50 floors. These are mainly residential buildings.

4.06 Cape Town (South Africa)

The town was founded in 1652; the city is home to about 433,700 inhabitants in 2011 on an area of 2,461 km². This results in a population density of 1,083 inhabitants per km². A list of 20 high-rise buildings is available. The buildings were handed over to their intended purpose between 1939 and 2021. The high-rise buildings have a height of between 58 m and 136 m. The buildings count between 14 and 36 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.06-1) shows that 50% of the buildings are located in the interval of 51 to 100 m. Then, some 50% of the buildings are located in the interval of 101 to 150 m. In the Top 2, office buildings and residential buildings can be found.

Table 4.06-01: Distribution of high-rise buildings by type of use and building height in Cape Town (South Africa).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Government	0.0	5.0	5.0	0.0	0.0	**10.0**
Hotel	0.0	5.0	5.0	0.0	0.0	**10.0**
Hotel / Museum	0.0	5.0	0.0	0.0	0.0	**5.0**
Office	0.0	15.0	20.0	0.0	0.0	**35.0**
Office / Residential	0.0	0.0	5.0	0.0	0.0	**5.0**
Residential	0.0	20.0	5.0	0.0	0.0	**25.0**
Residential / Hotel	0.0	0.0	5.0	0.0	0.0	**5.0**
Residential / Office	0.0	0.0	5.0	0.0	0.0	**5.0**
Sum, %	**0.0**	**50.0**	**50.0**	**0.0**	**0.0**	**100.0**

Table 4.06-2: Distribution of high-rise buildings by type of use and number of floors in Cape Town (South Africa).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Government	0.0	0.0	10.0	0.0	0.0	**10.0**
Hotel	0.0	0.0	5.0	5.0	0.0	**10.0**
Hotel / Museum	0.0	5.0	0.0	0.0	0.0	**5.0**
Office	0.0	0.0	35.0	0.0	0.0	**35.0**
Office / Residential	0.0	0.0	0.0	5.0	0.0	**5.0**
Residential	0.0	5.0	15.0	5.0	0.0	**25.0**
Residential / Hotel	0.0	0.0	5.0	0.0	0.0	**5.0**
Residential / Office	0.0	0.0	0.0	5.0	0.0	**5.0**
Sum, %	**0.0**	**10.0**	**70.0**	**20.0**	**0.0**	**100.0**

Table 4.06-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 70% of all buildings have 21 to 30 floors. These are mainly office buildings.

4.07 Chennai (India)

Founded in 1639 under the name Madras, renamed in 1996 to Chennai (Federal state Tamil Nadu), the city is home to about 4,646,700 inhabitants in 2011 on an area of 174 km². This results in a population density of 26,700 inhabitants per km². A list of 91 high-rise buildings is available. The buildings were handed over to their intended purpose between 1999 and 2024. The high-rise buildings have a height of between 71 m and 172 m. The buildings count between 18 and 47 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.07-1) shows that 59% of the buildings are located in the interval of 51 to 100 m. Then, some 38% of the buildings are located at 101 to 150 m intervals. The top 1 residential building can be found.

Table 4.07-01: Distribution of high-rise buildings by type of use and building height in Chennai (India).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	2.2	1.1	0.0	0.0	**3.3**
Office	0.0	1.1	1.1	0.0	0.0	**2.2**
Residential	0.0	56.0	36.3	2.2	0.0	**94.5**
Sum, %	**0.0**	**59.3**	**38.5**	**2.2**	**0.0**	**100.0**

Table 4.07-02: Distribution of high-rise buildings by type of use and number of floors in Chennai (India).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	1.1	2.2	0.0	0.0	**3.3**
Office	0.0	0.0	2.2	0.0	0.0	**2.2**
Residential	0.0	52.7	33.0	8.8	0.0	**94.5**
Sum, %	**0.0**	**53.8**	**37.4**	**8.8**	**0.0**	**100.0**

Table 4.07-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 54% of all buildings have 11 to 20 floors. These are mainly residential buildings. Then, 37% of all buildings have 21 to 30 floors. These are mainly residential buildings too.

4.08 Delhi (India)

The city was founded as the Capital of the Delhi Sultanate in 1214, then became the capital of the Mughal Empire in 1526. New Delhi raced as the capital of the British Indian Empire in 1911. Then, New Delhi became the capital of the Republic of India in 1950. The city became a Union Territory in 1956 and a National Capital Territory in 1992. The city is home to about 16,787,900 inhabitants in 2011 on an area of 1,484 km². This results in a population density of 11,300 inhabitants per km². A list of 54 high-rise buildings is available. The buildings were handed over to their intended purpose between 2013 and 2024. The high-rise buildings have a height of between 125 m and 300 m. The buildings count between 30 and 80 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.08-1) shows that 56% of the buildings are located in the interval of 101 to 150 m. Then, some 42% of the buildings are located at 151 to 200 m. The top 1 residential building can be found.

Table 4.08-1: Distribution of high-rise buildings by type of use and building height in Delhi (NCR, India).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	0.0	5.6	3.7	0.0	**9.3**
Office	0.0	0.0	0.0	3.7	1.9	**5.6**
Residential	0.0	0.0	50.0	35.2	0.0	**85.2**
Sum, %	**0.0**	**0.0**	**55.6**	**42.6**	**1.9**	**100.0**

Table 4.08-2: Distribution of high-rise buildings by type of use and number of floors in Delhi (NCR, India).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	0.0	3.7	5.6	0.0	**9.3**
Office	0.0	0.0	0.0	3.7	1.9	**5.6**
Residential	0.0	0.0	0.0	81.5	3.7	**85.2**
Sum, %	**0.0**	**0.0**	**3.7**	**90.7**	**5.6**	**100.0**

Table 4.08-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 90% of all buildings have 31 to 50 floors. These are mainly residential buildings.

4.09 Dhaka (Bangladesh)

The city is home to about 10,295,400 inhabitants in 2022 on an area of 306 km². This results in a population density of 33,645 inhabitants per km². A list of 62 high-rise buildings is available. The buildings were handed over to their intended purpose between 1971 and 2024. The high-rise buildings have a height of between 61 m and 171 m. The buildings count between 18 and 40 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.09-1) shows that 85% of the buildings are located in the interval of 51 to 100 m. In the Top three, commercial buildings, mixed-use buildings, and hotels can be found.

Table 4.09-1: Distribution of high-rise buildings by type of use and building height in Dhaka (Bangladesh).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	50.8	3.3	3.3	0.0	**57.4**
Educational	0.0	0.0	1.6	0.0	0.0	**1.6**
Hotel	0.0	11.5	1.6	0.0	0.0	**13.1**
Mixed-use	0.0	13.1	3.3	0.0	1.6	**18.0**
Office	0.0	1.6	0.0	0.0	0.0	**1.6**
Residential	0.0	8.2	0.0	0.0	0.0	**8.2**
Sum	**0.0**	**85.2**	**9.8**	**3.3**	**1.6**	**100.0**

Table 4.09-2: Distribution of high-rise buildings by type of use and number of floors in Dhaka (Bangladesh).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	24.6	27.9	4.9	0.0	**57.4**
Educational	0.0	1.6	0.0	0.0	0.0	**1.6**
Hotel	0.0	4.9	6.6	1.6	0.0	**13.1**
Mixed-use	0.0	8.2	8.2	1.6	0.0	**18.0**
Office	0.0	0.0	1.6	0.0	0.0	**1.6**
Residential	0.0	3.3	4.9	0.0	0.0	**8.2**
Sum, %	**0.0**	**42.6**	**49.2**	**8.2**	**0.0**	**100.0**

Table 4.09-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 49% of all buildings have 21 to 30 floors. These are mainly commercial buildings. Then some 43% of the buildings have 11 to 20 floors. These are mainly commercial buildings too.

4.10 Dubai (Emirate of Dubai, United Arab Emirates)

The first settlement was noticed in 1822. The city is home to about 3,790,000 inhabitants in 2024 on an area of 35 km² (metro area counts 1,994 km²). This results in a population density of 110,000 inhabitants per km². A list of 170 high-rise buildings is available. The buildings were handed over to their intended purpose between 1980 and 2024. The high-rise buildings have a height of between 50 m and 828 m. The buildings count between 10 and 163 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.10-1) shows that 68% of the buildings are located in intervals of more than 200 m. The top 2 residential buildings and hotels can be found here.

Table 4.10-1: Distribution of high-rise buildings by type of use and building height in Dubai (UAE).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.6	0.6	2.4	3.5	9.4	16.5
Hotel, Residential	0.0	0.0	0.0	0.6	7.6	8.2
Hotel, Residential, Offices	0.0	0.0	0.0	0.0	0.6	0.6
Offices	0.0	0.6	1.8	4.7	3.5	10.6
Offices, Hotel	0.0	0.0	0.0	0.6	0.0	0.6
Offices, Residential	0.0	0.0	0.0	1.8	1.8	3.5
Residential	0.0	0.0	1.8	12.9	45.3	60.0
Sum, %	**0.6**	**1.2**	**5.9**	**24.1**	**68.2**	**100.0**

Table 4.10-2: Distribution of high-rise buildings by type of use and number of floors in Dubai (UAE).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.6	0.6	2.4	3.5	9.4	**16.5**
Hotel, Residential	0.0	0.0	0.0	0.6	7.6	**8.2**
Hotel, Residential, Offices	0.0	0.0	0.0	0.0	0.6	**0.6**
Offices	0.0	0.6	1.8	4.7	3.5	**10.6**
Offices, Hotel	0.0	0.0	0.0	0.6	0.0	**0.6**
Offices, Residential	0.0	0.0	0.0	1.8	1.8	**3.5**
Residential	0.0	0.0	1.8	12.9	45.3	**60.0**
Sum, %	**0.6**	**1.2**	**5.9**	**24.1**	**68.2**	**100.0**

Table 4.10-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 68% of all buildings have more than 50 floors. These are mainly residential buildings. Then some 24% of the buildings have 31 to 50 floors. These are mainly residential buildings too.

4.11 Frankfurt Main (Germany)

Frankfurt was first mentioned in 794 in a document of Charle the Great for the Regensburg monastery of St. Emmeram. In 1994, the city celebrated its 1,200th anniversary. The city is home to about 749,596 inhabitants in 2023 on an area of 248,31 km². This results in a population density of 3,019 inhabitants per km². A list of 128 high-rise buildings is available. The buildings were handed over to their intended purpose between 1963 and 2024. The high-rise buildings have a height of between 50 m and 259 m. The buildings count between 11 and 59 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.11-1) shows that 64% of the buildings are located in the interval of 51-100 m. In the Top 2, office and residential buildings can be found.

Table 4.11-1: Distribution of high-rise buildings by type of use and building height in Frankfurt Main (Germany).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	0.8	0.0	0.0	0.0	**0.8**
Hotel	0.8	4.7	0.0	0.0	0.0	**5.5**
Hotel, Offices	0.0	0.0	0.8	1.6	0.0	**2.3**
Hotel, Offices, Residential	0.0	0.8	0.0	0.0	0.0	**0.8**
Hotel, Residential	0.0	0.0	0.8	0.0	0.0	**0.8**
Offices	3.1	35.2	10.2	6.3	2.3	**57.0**
Offices, Bank	0.0	0.8	1.6	1.6	0.0	**3.9**
Offices, Gym, Restaurant, Café	0.0	0.0	0.0	0.8	0.0	**0.8**
Offices, Residential	0.0	0.8	0.8	0.8	0.0	**2.3**
Offices, Residential, Hotel	0.0	0.0	0.0	0.0	0.8	**0.8**
Offices, Restaurants	0.0	0.8	0.0	0.0	0.0	**0.8**
Offices, Theater	0.0	0.0	0.8	0.0	0.0	**0.8**
Offices, Restaurants	0.0	0.0	0.8	0.0	0.0	**0.8**
Residential	0.0	19.5	0.8	1.6	0.0	**21.9**
Residential, Hotel	0.0	0.8	0.0	0.0	0.0	**0.8**
Sum, %	**3.9**	**64.1**	**16.4**	**12.5**	**3.1**	**100.0**

Table 4.11-2: Distribution of high-rise buildings by type of use and number of floors in Frankfurt Main (Germany).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	0.0	0.8	0.0	0.0	**0.8**
Hotel	0.0	3.1	2.3	0.0	0.0	**5.5**
Hotel, Offices	0.0	0.0	0.0	2.3	0.0	**2.3**
Hotel, Offices, Residential	0.0	0.0	0.8	0.0	0.0	**0.8**
Hotel, Residential	0.0	0.0	0.0	0.8	0.0	**0.8**
Offices	0.0	32.0	13.3	8.6	3.1	**57.0**
Offices, Bank	0.0	0.8	0.0	3.1	0.0	**3.9**
Offices, Gym, Restaurant, Café	0.0	0.0	0.0	0.0	0.8	**0.8**
Offices, Residential	0.0	0.0	0.8	1.6	0.0	**2.3**
Offices, Residential, Hotel	0.0	0.0	0.0	0.0	0.8	**0.8**
Offices, Restaurants	0.0	0.8	0.0	0.0	0.0	**0.8**
Offices, Theater	0.0	0.0	0.0	0.8	0.0	**0.8**
Offices, Restaurants	0.0	0.0	0.8	0.0	0.0	**0.8**
Residential	0.0	13.3	6.3	2.3	0.0	**21.9**
Residential, Hotel	0.0	0.0	0.8	0.0	0.0	**0.8**
Sum, %	**0.0**	**50.0**	**25.8**	**19.5**	**4.7**	**100.0**

Table 4.11-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 50% of all buildings have 11-20 floors. These are mainly office buildings and residential buildings. Then some 26% of the buildings have 21 to 30 floors. These are mainly office buildings.

4.12 Greater Manchester (UK)

Greater Manchester is a county in England. The county has an area of 1,276 km^2 and is highly urbanized, with a population of 2.911 million (2022). This results in a population density of 2,282 inhabitants per km^2. The largest settlement is the city of Manchester. A list of 196 high-rise buildings is available. The buildings were handed over to their intended purpose between 1896 and 2024. The high-rise buildings have a height of between 50 m and 201 m. The buildings count between 8 and 65 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.12-1) shows that 81% of the buildings are located in the interval of 51-100 m. In the Top two, residential and office buildings can be found.

Table 4.12-1: Distribution of high-rise buildings by type of use and building height in Greater Manchester (UK).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Government	0.0	1.5	0.0	0.0	0.0	**1.5**
Government, Office	0.0	0.5	0.0	0.0	0.0	**0.5**
Hotel	1.0	5.1	0.0	0.0	0.0	**6.1**
Hotel, Residential	0.0	1.0	0.0	0.5	0.0	**1.5**
Museum	0.0	0.5	0.0	0.0	0.0	**0.5**
Office	1.0	14.3	1.0	0.0	0.0	**16.3**
Office, Residential	0.0	2.0	0.0	0.0	0.0	**2.0**
Office, Dormitory	0.0	0.5	0.0	0.0	0.0	**0.5**
Prison	0.0	0.5	0.0	0.0	0.0	**0.5**
Residential	4.1	51.0	7.1	2.6	0.5	**65.3**
Dormitory	0.5	3.1	0.5	0.0	0.0	**4.1**
Theatre	0.0	0.5	0.0	0.0	0.0	**0.5**
University	0.0	0.5	0.0	0.0	0.0	**0.5**
Sum, %	**6.6**	**81.1**	**8.7**	**3.1**	**0.5**	**100.0**

Table 4.12-2: Distribution of high-rise buildings by type of use and number of floors in Greater Manchester (UK).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Government	0.0	1.5	0.0	0.0	0.0	**1.5**
Government, Office	0.0	0.5	0.0	0.0	0.0	**0.5**
Hotel	0.0	4.6	1.5	0.0	0.0	**6.1**
Hotel, Residential	0.0	1.0	0.0	0.5	0.0	**1.5**
Museum	0.5	0.0	0.0	0.0	0.0	**0.5**
Office	1.0	13.3	2.0	0.0	0.0	**16.3**
Office, Residential	0.0	2.0	0.0	0.0	0.0	**2.0**
Office, Dormitory	0.0	0.0	0.0	0.5	0.0	**0.5**
Prison	0.0	0.5	0.0	0.0	0.0	**0.5**
Residential	0.0	28.6	25.0	9.7	2.0	**65.3**
Dormitory	0.0	3.1	0.0	1.0	0.0	**4.1**
Theatre	0.5	0.0	0.0	0.0	0.0	**0.5**
University	0.0	0.5	0.0	0.0	0.0	**0.5**
Sum, %	**2.0**	**55.6**	**28.6**	**11.7**	**2.0**	**100.0**

Table 4.12-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 56% of all buildings have 11-20 floors. These are mainly residential buildings and office buildings. Then some 29% of the buildings have 21 to 30 floors. These are mainly residential buildings.

4.13 Hanoi (Vietnam)

Hanoi is an administrative unit (province) with an area of 3,324.92 km². In 2019, the city had a population of around 8,053,000, resulting in a population density of 2,422 inhabitants per km².

For the presentation of the high-rise situation, only a table from the Statistical Yearbook is available (Table 4.13-1).

Table 4.13-1: Distribution of high-rise buildings by number of floors and type of use in Hanoi (Vietnam).

Buildings	Number of floors				Use of building			
	9-19	20-29	30 and more	Sum	Public	Mix used	Residential	Sum
Number	279	200	99	578	92	253	233	578
%	**48.3**	**34.6**	**17.1**	**100.0**	**15.9**	**43.8**	**40.3**	**100.0**

48% of the buildings have 9 to 19 floors. This is followed by buildings with 20 to 29 floors (35%). With regard to the use of high-rise buildings, 44% are "mix used", followed by residential buildings (40%).

4.14 Hong Kong (China)

The city is home to about 7,340,000 inhabitants in 2021 on an area of 1,114.6 km². This results in a population density of 6,890 inhabitants per km². A list of 173 high-rise buildings is available. The buildings were handed over to their intended purpose between 1980 and 2023. The high-rise buildings have a height of between 179 m and 484 m. The buildings count between 10 and 36 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.04-1) shows that 53% of the buildings are located in the interval of 151 to 200 m. Furthermore, 47% of the high-rise buildings have a height of more than 200 m. In the Top 2, residential and office buildings can be found.

Table 4.14-1: Distribution of high-rise buildings by type of use and building height in Hong Kong (China).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	0.0	0.0	0.6	0.0	**0.6**
Government	0.0	0.0	0.0	0.0	0.6	**0.6**
Hotel	0.0	0.0	0.0	0.0	0.6	**0.6**
Hotel, Office	0.0	0.0	0.0	0.6	1.7	**2.3**
Hotel, Residential	0.0	0.0	0.0	0.6	1.7	**2.3**
Office	0.0	0.0	0.0	12.7	9.8	**22.5**
Office, Industrial	0.0	0.0	0.0	0.6	0.0	**0.6**
Office, Retail	0.0	0.0	0.0	0.0	0.6	**0.6**
Residential	0.0	0.0	0.0	37.6	32.4	**69.9**
Sum, %	**0.0**	**0.0**	**0.0**	**52.6**	**47.4**	**100.0**

Table 4.14-2: Distribution of high-rise buildings by type of use and number of floors in Hong Kong (China).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	0.0	0.0	0.6	0.0	**0.6**
Government	0.0	0.0	0.0	0.6	0.0	**0.6**
Hotel	0.0	0.0	0.0	0.0	0.6	**0.6**
Hotel, Office	0.0	0.0	0.0	0.6	1.7	**2.3**
Hotel, Residential	0.0	0.0	0.0	0.0	2.3	**2.3**
Office	0.0	0.0	0.0	13.9	8.7	**22.5**
Office, Industrial	0.0	0.0	0.0	0.6	0.0	**0.6**
Office, Retail	0.0	0.0	0.0	0.6	0.0	**0.6**
Residential	0.0	0.0	0.0	8.1	61.8	**69.9**
Sum, %	**0.0**	**0.0**	**0.0**	**24.9**	**75.1**	**100.0**

Table 4.14-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 75% of all buildings have more than 50 floors. These are mainly residential buildings and office buildings. Then some 25% of the buildings have 31 to 50 floors. These are mainly office buildings.

4.15 Istanbul (Türkiye)

The city is located on the northern shore of the Sea of Marmara on both sides of the Bosphorus, i.e., both in European Thrace and Asian Anatolia. Founded in 660 BC under the name Byzantium, the city can look back on 2,700 years of history. For almost 1,600 years, it served successively as the capital of the Roman, Byzantine, and Ottoman Empires. Today, Istanbul is a province and a city with an area of 5,220 km². Fifteen million eight hundred forty thousand nine hundred inhabitants were counted in 2021. Thus, the population density is 3,035 inhabitants per km². Istanbul is the largest city in Türkiye, ahead of Ankara (4,400,000 inhabitants, 2010); here, the correct spelling of the country name is observed! As of 2020, there were 1,167 high-rise residential buildings (> 15 floors) in the City of Istanbul. A list of 72 high-rise buildings is available. The buildings were handed over to their intended purpose between 1993 and 2024. The high-rise buildings have a height between 142 m and 352 m and 30 to 65 floors. Other high-rise buildings are certainly located in the city but outside the intervals just described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.04-1) shows that 61% of the buildings are located in the interval of 151 to 200 m. Furthermore, 22% of the high-rise buildings have heights in the interval of 101 to 150 m. In the Top 2, residential and office buildings can be found.

Table 4.15-1: Distribution of high-rise buildings by type of use and building height in Istanbul (Türkiye).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	0.0	0.0	2.8	0.0	**2.8**
Hotel / Office	0.0	0.0	2.8	5.6	0.0	**8.3**
Hotel / Residential / Office	0.0	0.0	0.0	0.0	1.4	**1.4**
Hotel / Serviced Apartments / Residential	0.0	0.0	0.0	0.0	1.4	**1.4**
Office	0.0	0.0	4.2	12.5	8.3	**25.0**
Office / Residential / Retail	0.0	0.0	0.0	1.4	0.0	**1.4**
Residential	0.0	0.0	11.1	30.6	4.2	**45.8**
Residential / Hotel	0.0	0.0	0.0	2.8	0.0	**2.8**
Residential / Office	0.0	0.0	2.8	4.2	0.0	**6.9**
Residential / Office / Retail	0.0	0.0	0.0	1.4	1.4	**2.8**
Retail / Office	0.0	0.0	1.4	0.0	0.0	**1.4**
Sum, %	**0.0**	**0.0**	**22.2**	**61.1**	**16.7**	**100.0**

Table 4.15-2: Distribution of high-rise buildings by type of use and number of floors in Istanbul (Türkiye).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	0.0	0.0	2.8	0.0	**2.8**
Hotel / Office	0.0	0.0	0.0	8.3	0.0	**8.3**
Hotel / Residential / Office	0.0	0.0	0.0	0.0	1.4	**1.4**
Hotel / Serviced Apartments / Residential	0.0	0.0	0.0	0.0	1.4	**1.4**
Office	0.0	0.0	0.0	19.4	5.6	**25.0**
Office / Residential / Retail	0.0	0.0	0.0	1.4	0.0	**1.4**
Residential	0.0	0.0	0.0	36.1	9.7	**45.8**
Residential / Hotel	0.0	0.0	0.0	2.8	0.0	**2.8**
Residential / Office	0.0	0.0	0.0	6.9	0.0	**6.9**
Residential / Office / Retail	0.0	0.0	0.0	1.4	1.4	**2.8**
Retail / Office	0.0	0.0	1.4	0.0	0.0	**1.4**
Sum, %	**0.0**	**0.0**	**1.4**	**79.2**	**19.4**	**100.0**

Table 4.15-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 79% of all buildings have 31 to 50 floors, mainly residential and office buildings. Then, some 19% of the buildings have more than 50 floors, mainly residential buildings.

4.16 Jakarta (Indonesia)

Jakarta was founded in 1527. The city is home to about 10,562,088 inhabitants in 2020 on an area of 661.5 km². This results in a population density of 15,966 inhabitants per km². A list of 88 high-rise buildings is available. The buildings were handed over to their intended purpose between 1996 and 2024. The high-rise buildings have a height of between 160 m and 383 m. The buildings count between 32 and 75 floors. Other high-rise buildings are located in the city outside the intervals described.

Table 4.16-1: Distribution of high-rise buildings by type of use and building height in Jakarta (Indonesia).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	0.0	0.0	0.0	1.1	**1.1**
Hotel / Office	0.0	0.0	0.0	1.1	2.3	**3.4**
Hotel / Residential / Office / Retail	0.0	0.0	0.0	0.0	1.1	**1.1**
Office	0.0	0.0	0.0	19.3	26.1	**45.5**
Office / Retail	0.0	0.0	0.0	1.1	1.1	**2.3**
Residential	0.0	0.0	0.0	17.0	18.2	**35.2**
Residential / Hotel	0.0	0.0	0.0	1.1	3.4	**4.5**
Residential / Hotel / Office	0.0	0.0	0.0	1.1	0.0	**1.1**
Residential / Office / Retail	0.0	0.0	0.0	0.0	1.1	**1.1**
Residential / Retail	0.0	0.0	0.0	2.3	1.1	**3.4**
Serviced Apartments / Residential	0.0	0.0	0.0	1.1	0.0	**1.1**
Sum, %	**0.0**	**0.0**	**0.0**	**44.3**	**55.7**	**100.0**

Table 4.16-2: Distribution of high-rise buildings by type of use and number of floors in Jakarta (Indonesia).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	0.0	0.0	1.1	0.0	**1.1**
Hotel / Office	0.0	0.0	0.0	1.1	2.3	**3.4**
Hotel / Residential / Office / Retail	0.0	0.0	0.0	0.0	1.1	**1.1**
Office	0.0	0.0	0.0	35.2	10.2	**45.5**
Office / Retail	0.0	0.0	0.0	2.3	0.0	**2.3**
Residential	0.0	0.0	0.0	22.7	12.5	**35.2**
Residential / Hotel	0.0	0.0	0.0	2.3	2.3	**4.5**
Residential / Hotel / Office	0.0	0.0	0.0	1.1	0.0	**1.1**
Residential / Office / Retail	0.0	0.0	0.0	1.1	0.0	**1.1**
Residential / Retail	0.0	0.0	0.0	2.3	1.1	**3.4**
Serviced Apartments / Residential	0.0	0.0	0.0	1.1	0.0	**1.1**
Sum, %	**0.0**	**0.0**	**0.0**	**70.5**	**29.5**	**100.0**

The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.16-1) shows that nearly 56% of the buildings are located in intervals of more than 200 m. More than 44% of high-rise buildings are located in intervals of 151 to 200 m. In the Top 2, office buildings and residential buildings can be found.

Table 4.16-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 70% of all buildings have 31 to 50 floors. These are mainly office buildings and residential buildings. Then some 29% of the buildings have more than 50 floors. These are mainly residential and office buildings.

4.17 Johannesburg (South Africa)

Johannesburg is a metropolitan municipality in the province of Gauteng and was founded in 1886. It covers an area of 1,645 km² and has a population of 4,803,000 (2022). This results in a population density of 2,920 people per km². A list of 21 high-rise buildings is available. The buildings were handed over to their intended purpose between 1965 and 2019. The high-rise buildings have a height of between 66 m and 228 m. The buildings count between 17 and 56 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.17-1) shows that nearly 62% of the buildings are located in the interval 101 to 150 m. The Top 2 office buildings and residential buildings can be found.

Table 4.17-1: Distribution of high-rise buildings by type of use and building height in Johannesburg (South Africa).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	0.0	9.5	0.0	0.0	**9.5**
Hotel / Residential / Office	0.0	0.0	0.0	0.0	4.8	**4.8**
Office	0.0	9.5	42.9	9.5	4.8	**66.7**
Residential	0.0	4.8	9.5	4.8	0.0	**19.0**
Sum, %	**0.0**	**14.3**	**61.9**	**14.3**	**9.5**	**100.0**

Table 4.17-2: Distribution of high-rise buildings by type of use and number of floors in Johannesburg (South Africa).

Number of Floors	**≤10**	**11 -- 20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	0.0	4.8	4.8	0.0	**9.5**
Hotel / Residential / Office	0.0	0.0	0.0	0.0	4.8	**4.8**
Office	0.0	0.0	38.1	28.6	0.0	**66.7**
Residential	0.0	4.8	4.8	4.8	4.8	**19.0**
Sum, %	**0.0**	**4.8**	**47.6**	**38.1**	**9.5**	**100.0**

Table 4.17-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 48% of all buildings have 21 to 30 floors, and 38% have 31 to 50 floors. These are mainly office buildings and residential buildings.

4.18 Karachi (Pakistan)

Karachi is the largest city in Pakistan and the capital of the province of Sindh. The population is given as about 23.4 million. The city area is about 3,530 km². Of this, 591 km² (17%) belong to the core city (high building density). 2,936 km² (83 %) comprises suburbs and areas with a rural settlement structure. This results in a population density of 5,779 inhabitants per km². A list of 27 high-rise buildings is available. The buildings were handed over to their intended purpose between 1963 and 2022. The high-rise buildings have a height of between 100 m and 300 m. The buildings count between 19 and 62 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.18-1) shows that 78% of the buildings are located in the interval of 101-150 m. In the Top two, office and residential buildings can be found.

Table 4.18-1: Distribution of high-rise buildings by type of use and building height in Karachi (Pakistan).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Commercial	0.0	0.0	11.1	0.0	0.0	**11.1**
Mixed Use	0.0	0.0	14.8	0.0	3.7	**18.5**
Office	0.0	7.4	22.2	3.7	0.0	**33.3**
Residential	0.0	0.0	29.6	7.4	0.0	**37.0**
Sum, %	**0.0**	**7.4**	**77.8**	**11.1**	**3.7**	**100.0**

Table 4.18-2: Distribution of high-rise buildings by type of use and number of floors in Karachi (Pakistan).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Commercial	0.0	3.7	7.4	0.0	0.0	**11.1**
Mixed Use	0.0	0.0	3.7	11.1	3.7	**18.5**
Office	0.0	0.0	29.6	3.7	0.0	**33.3**
Residential	0.0	0.0	18.5	18.5	0.0	**37.0**
Sum, %	**0.0**	**3.7**	**59.3**	**33.3**	**3.7**	**100.0**

Table 4.18-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 59% of all buildings have 21 to 30 floors, and 33% have 31 to 50 floors. These are mainly office buildings and residential buildings.

4.19 London (UK)

London is also the capital of the United Kingdom and England. The current administrative area of 33 boroughs was created in 1965 with the creation of Greater London. Today, the city has an area of 1,572 km². Eight million eight hundred sixty-six thousand one hundred eighty inhabitants were counted in 2022. Thus, the population density is 5,597 inhabitants per km².

Table 4.19-1: Distribution of high-rise buildings by type of use and building height in London (UK).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Government	0.0	0.0	0.8	0.0	0.0	**0.8**
Hospital	0.0	0.0	0.8	0.0	0.0	**0.8**
Hotel	0.0	0.0	2.4	0.0	0.0	**2.4**
Industrial	0.0	0.0	0.8	0.0	0.0	**0.8**
Mixed	0.0	0.0	0.0	0.8	0.8	**1.6**
Office	0.0	0.8	13.0	10.6	4.1	**28.5**
Office, Dormitory	0.0	0.0	0.8	0.0	0.0	**0.8**
Residential	0.0	2.4	43.9	10.6	4.1	**61.0**
Residential, Dormitory	0.0	0.0	0.8	0.0	0.0	**0.8**
Stadium	0.0	0.0	0.8	0.0	0.0	**0.8**
Transmitter and Office	0.0	0.0	0.0	0.8	0.0	**0.8**
Viewing platform	0.0	0.0	0.8	0.0	0.0	**0.8**
Sum, %	**0.0**	**3.3**	**65.0**	**22.8**	**8.9**	**100.0**

Table 4.19-2: Distribution of high-rise buildings by type of use and number of floors in London (UK).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Government	0.0	0.0	0.0	0.8	0.0	**0.8**
Hospital	0.0	0.0	0.0	0.8	0.0	**0.8**
Hotel	0.0	0.0	0.8	1.6	0.0	**2.4**
Industrial	0.8	0.0	0.0	0.0	0.0	**0.8**
Mixed	0.0	0.0	0.0	0.8	0.8	**1.6**
Office	0.0	0.8	8.9	17.1	1.6	**28.5**
Office, Dormitory	0.0	0.0	0.0	0.8	0.0	**0.8**
Residential	0.0	0.0	5.7	44.7	10.6	**61.0**
Residential, Dormitory	0.0	0.0	0.0	0.8	0.0	**0.8**
Stadium	0.8	0.0	0.0	0.0	0.0	**0.8**
Transmitter and Office	0.0	0.0	0.0	0.8	0.0	**0.8**
Viewing platform	0.8	0.0	0.0	0.0	0.0	**0.8**
Sum, %	**2.4**	**0.8**	**15.4**	**68.3**	**13.0**	**100.0**

A list of 127 high-rise buildings is available. The buildings were handed over to their intended purpose between 1858 and 2024. The high-rise buildings have a height of between 100 m and 310 m. The buildings count between 10 and 87 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.19-1) shows that 65% of the buildings are located in the interval of 101 to 150 m, followed by the interval of 151 to 200 m (23%). In the Top 2, residential and commercial buildings can be found. Table 4.19-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 68% of all buildings have 31 to 50 floors, mainly residential buildings.

4.20 Madrid (Spain)

The town was founded in the 9th century, and the city is home to about 3,416,700 inhabitants in 2024 on an area of 605.77 km². This results in a population density of 5,640 inhabitants per km². A list of 34 high-rise buildings is available. The buildings were handed over to their intended purpose between 1929 and 2022. The high-rise buildings have a height of between 71 m and 250 m. The buildings count between 14 and 52 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.20-1) shows that 59% of the buildings are located in the interval 51 to 100 m. Some 23% of the buildings follow in the interval 101 to 150 m. In the Top 2, residential and office buildings can be found.

Table 4.20-1: Distribution of high-rise buildings by type of use and building height in Madrid (Spain).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Hospital	0.0	2.9	0.0	0.0	0.0	**2.9**
Hotel, office	0.0	0.0	2.9	0.0	0.0	**2.9**
Office	0.0	14.7	17.6	5.9	8.8	**47.1**
Office, hotel	0.0	0.0	0.0	0.0	2.9	**2.9**
Office, residential	0.0	5.9	0.0	0.0	0.0	**5.9**
Residential	0.0	35.3	0.0	0.0	0.0	**35.3**
Residential, office	0.0	0.0	2.9	0.0	0.0	**2.9**
Sum, %	**0.0**	**58.8**	**23.5**	**5.9**	**11.8**	**100.0**

Table 4.20-2: Distribution of high-rise buildings by type of use and number of floors in Madrid (Spain).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Hospital	0.0	0.0	2.9	0.0	0.0	**2.9**
Hotel, office	0.0	0.0	2.9	0.0	0.0	**2.9**
Office	0.0	5.9	23.5	11.8	5.9	**47.1**
Office, hotel	0.0	0.0	0.0	0.0	2.9	**2.9**
Office, residential	0.0	0.0	5.9	0.0	0.0	**5.9**
Residential	0.0	0.0	35.3	0.0	0.0	**35.3**
Residential, office	0.0	0.0	0.0	2.9	0.0	**2.9**
Sum, %	**0.0**	**5.9**	**70.6**	**14.7**	**8.8**	**100.0**

Table 4.20-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 71% of all buildings have 21 to 30 floors. These are mainly residential buildings and office buildings.

4.21 Mexico City (Mexico)

The town was founded in 1521. Today, the city is home to about 9,209,900 inhabitants in 2020 on an area of 1,497 km². This results in a population density of 6,160 inhabitants per km². A list of 51 high-rise buildings is available. The buildings were handed over to their intended purpose between 1956 and 2023. The high-rise buildings have a height of between 126 m and 266 m. The buildings count between 25 and 66 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.21-1) shows that 49% of the buildings are located in the interval of 101 to 150 m. A second interval counts buildings from 151 to 200 m (39%). The Top 2 office buildings and residential buildings can be found.

Table 4.21-1: Distribution of high-rise buildings by type of use and building height in Mexico-City (Mexico).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	0.0	3.9	2.0	0.0	**5.9**
Office	0.0	0.0	15.7	21.6	7.8	**45.1**
Office / Retail	0.0	0.0	2.0	0.0	0.0	**2.0**
Residential	0.0	0.0	21.6	11.8	2.0	**35.3**
Residential / Hotel	0.0	0.0	2.0	0.0	0.0	**2.0**
Residential / Hotel / Office	0.0	0.0	2.0	0.0	2.0	**3.9**
Residential / Office	0.0	0.0	2.0	2.0	0.0	**3.9**
Retail / Residential	0.0	0.0	0.0	2.0	0.0	**2.0**
Sum, %	**0.0**	**0.0**	**49.0**	**39.2**	**11.8**	**100.0**

Table 4.21-2: Distribution of high-rise buildings by type of use and number of floors in Mexico-City (Mexico).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	0.0	0.0	5.9	0.0	**5.9**
Office	0.0	0.0	9.8	29.4	5.9	**45.1**
Office / Retail	0.0	0.0	2.0	0.0	0.0	**2.0**
Residential	0.0	0.0	3.9	23.5	7.8	**35.3**
Residential / Hotel	0.0	0.0	0.0	2.0	0.0	**2.0**
Residential / Hotel / Office	0.0	0.0	0.0	2.0	2.0	**3.9**
Residential / Office	0.0	0.0	2.0	2.0	0.0	**3.9**
Retail / Residential	0.0	0.0	0.0	2.0	0.0	**2.0**
Sum, %	**0.0**	**0.0**	**17.6**	**66.7**	**15.7**	**100.0**

Table 4.21-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 67% of all buildings have 31 to 50 floors. These are mainly office buildings and residential buildings.

4.22 Mumbai (India)

The founding period of Bombay, as the city was called until 1995, is considered the 13th century. Today, Mumbai is the capital of the Indian state of Maharashtra. The city is home to about 15,414,000 inhabitants in 2018 on an area of 603.4 km². This results in a population density of 25,546 inhabitants per km². A list of 253 high-rise buildings is available. The buildings were handed over to their intended purpose between 1970 and 2024. The high-rise buildings have a height of between 150 m and 320 m. The buildings count between 27 and 88 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.22-1) shows that 56% of the buildings are located in the interval of 151 to 200 m. Some more than 30% are in intervals of more than 200 m. The majority of all buildings (89%) are residential buildings.

Table 4.22-1: Distribution of high-rise buildings by type of use and building height in Mumbai (India).

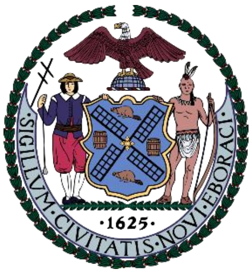
Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Commercial	0.0	0.0	0.8	4.7	1.2	**6.7**
Hotel	0.0	0.0	0.0	4.0	0.4	**4.3**
Residential	0.0	0.0	15.8	47.0	26.1	**88.9**
Sum, %	**0.0**	**0.0**	**16.6**	**55.7**	**27.7**	**100.0**

Table 4.22-2: Distribution of high-rise buildings by type of use and number of floors in Mumbai (India).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Commercial	0.0	0.0	0.0	4.7	2.0	**6.7**
Hotel	0.0	0.0	0.0	2.8	1.6	**4.3**
Residential	0.0	0.0	0.4	49.0	39.5	**88.9**
Sum, %	**0.0**	**0.0**	**0.4**	**56.5**	**43.1**	**100.0**

Table 4.22-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 56% of all buildings have 31 to 50 floors. Then some more, 43% have even more than 50 floors. These are mainly residential buildings.

4,23 New York City (USA)



The town was founded in 1625; the city is home to about 8,804,190 inhabitants in 2020 on an area of 789,4 km². This results in a population density of 11,153 inhabitants per km². A list of 109 high-rise buildings is available. The buildings were handed over to their intended purpose between 1909 and 2025. The high-rise buildings have a height of between 199 m and 541 m. The buildings count between 42 and 104 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.23-1) shows that 96% of the buildings are located in intervals of more than 200 m. The Top 2 office buildings and residential buildings can be found.

Table 4.23-1: Distribution of high-rise buildings by type of use and building height in New York City (USA).

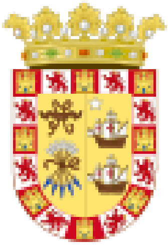
Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Office	0.0	0.0	0.0	0.9	48.6	**49.5**
Office, Hotel, Apartments	0.0	0.0	0.0	0.0	1.8	**1.8**
Office, Apartments	0.0	0.0	0.0	0.0	6.4	**6.4**
Retail, Apartments	0.0	0.0	0.0	0.0	0.9	**0.9**
Retail, Apartments	0.0	0.0	0.0	0.9	0.0	**0.9**
Hotel	0.0	0.0	0.0	0.0	1.8	**1.8**
Hotel, Apartments	0.0	0.0	0.0	0.0	2.8	**2.8**
Apartments	0.0	0.0	0.0	1.8	32.1	**33.9**
Apartments, Retail, Shops	0.0	0.0	0.0	0.0	1.8	**1.9**
Sum, %	**0.0**	**0.0**	**0.0**	**3.7**	**96.3**	**100.0**

Table 4.23-2: Distribution of high-rise buildings by type of use and number of floors in New York City (USA).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Office	0.0	0.0	0.0	14.7	34.9	**49.5**
Office, Hotel, Apartments	0.0	0.0	0.0	0.0	1.8	**1.8**
Office, Apartments	0.0	0.0	0.0	0.0	6.4	**6.4**
Retail, Apartments	0.0	0.0	0.0	0.0	0.9	**0.9**
Retail, Apartments	0.0	0.0	0.0	0.9	0.0	**0.9**
Hotel	0.0	0.0	0.0	0.0	1.8	**1.8**
Hotel, Apartments	0.0	0.0	0.0	0.0	2.8	**2.8**
Apartments	0.0	0.0	0.0	0.9	33.0	**33.9**
Apartments, Retail, Shops	0.0	0.0	0.0	0.0	1.8	**1.8**
Sum, %	**0.0**	**0.0**	**0.0**	**16.5**	**83.5**	**100.0**

Table 4.23-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 83% of all buildings have more than 50 floors. These are mainly office buildings and residential buildings.

4.24 Panama City (Panama)



The town was founded in 1519; the city is home to about 813,100 inhabitants in 2017 on an area of 2,561 km². This results in a population density of 275 inhabitants per km². A list of 90 high-rise buildings is available. The buildings were handed over to their intended purpose between 1979 and 2023. The high-rise buildings have a height of between 87 m and 284 m. The buildings count between 24 and 78 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.24-1) shows that 71% of the buildings are located in the interval of 101 to 200 m. Some more 28% are higher than 200 m. The top 2 residential buildings and office buildings can be found here.

Table 4.24-1: Distribution of high-rise buildings by type of use and building height in Panama-City (Panama).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Hotel	0.0	0.0	0.0	1.1	0.0	**1.1**
Hotel, Casino, Retail	0.0	0.0	1.1	0.0	0.0	**1.1**
Hotel, Office	0.0	0.0	0.0	0.0	2.2	**2.2**
Office	0.0	1.1	2.2	3.3	4.4	**11.1**
Residential	0.0	0.0	20.0	41.1	17.8	**78.9**
Residential, Hotel, Casino	0.0	0.0	0.0	0.0	2.2	**2.2**
Residential, Office	0.0	0.0	0.0	1.1	0.0	**1.1**
Serviced Apartments	0.0	0.0	0.0	0.0	1.1	**1.1**
Casino, hotel, office, retail	0.0	0.0	1.1	0.0	0.0	**1.1**
Sum, %	**0.0**	**1.1**	**24.4**	**46.7**	**27.8**	**100.0**

Table 4.24-2: Distribution of high-rise buildings by type of use and number of floors in Panama-City (Panama).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Hotel	0.0	0.0	0.0	1.1	0.0	**1.1**
Hotel, Casino, Retail	0.0	0.0	1.1	0.0	0.0	**1.1**
Hotel, Office	0.0	0.0	0.0	0.0	2.2	**2.2**
Office	0.0	0.0	1.1	6.7	3.3	**11.1**
Residential	0.0	0.0	0.0	46.7	32.2	**78.9**
Residential, Hotel, Casino	0.0	0.0	0.0	0.0	2.2	**2.2**
Residential, Office	0.0	0.0	0.0	1.1	0.0	**1.1**
Serviced Apartments	0.0	0.0	0.0	0.0	1.1	**1.1**
Casino, hotel, office, retail	0.0	0.0	1.1	0.0	0.0	**1.1**
Sum, %	**0.0**	**0.0**	**3.3**	**55.6**	**41.1**	**100.0**

Table 4.24-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 56% of all buildings have 31 to 50 floors, and 41 % have more than 50 floors. These are mainly office and residential buildings.

4.25 Paris (France)

The history of the city of Paris dates back over 2000 years. During this time, the town developed from the Celtic settlement of Lutetia of the Parisii tribe to today's metropolis and capital of France. The city is home to about 2,113,700 inhabitants in 2022 on an area of 105.4 km². This results in a population density of 20,054 inhabitants per km². A list of 82 high-rise buildings is available. The buildings were handed over to their intended purpose between 1967 and 2022. The high-rise buildings have a height of between 100 m and 232 m. The buildings count between 23 and 59 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.25-1) shows that 63% of the buildings are located in the interval of 101 to 150 m. Some more 24% of the high-rise buildings are 151 to 150 m high. The Top 2 office buildings and residential buildings can be found.

Table 4.25-1: Distribution of high-rise buildings by type of use and building height in Paris (France).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Courthouse	0.0	0.0	0.0	1.2	0.0	**1.2**
Hotel	0.0	1.2	2.4	0.0	0.0	**3.7**
Mixed	0.0	0.0	3.7	0.0	0.0	**3.7**
Monument, Office	0.0	0.0	1.2	0.0	0.0	**1.2**
Office	0.0	4.9	24.4	23.2	3.7	**56.1**
Office, Hotel	0.0	0.0	1.2	0.0	0.0	**1.2**
Residential	0.0	2.4	30.5	0.0	0.0	**32.9**
Sum, %	**0.0**	**8.5**	**63.4**	**24.4**	**3.7**	**100.0**

Table 4.25-2: Distribution of high-rise buildings by type of use and number of floors in Paris (France).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Courthouse	0.0	0.0	0.0	1.2	0.0	**1.2**
Hotel	0.0	0.0	0.0	3.7	0.0	**3.7**
Mixed	0.0	0.0	0.0	3.7	0.0	**3.7**
Monument, Office	0.0	0.0	0.0	1.2	0.0	**1.2**
Office	0.0	0.0	13.4	41.5	1.2	**56.1**
Office, Hotel	0.0	0.0	1.2	0.0	0.0	**1.2**
Residential	0.0	0.0	2.4	30.5	0.0	**32.9**
Sum, %	**0.0**	**0.0**	**17.1**	**81.7**	**1.2**	**100.0**

Table 4.25-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 82% of all buildings have 31 to 50 floors, and 17% have 21 to 30 floors. These are mainly office and residential buildings.

4.26 Perth (Australia)

The town was founded in 1829. Today, the city is home to about 2,085,900 inhabitants in 2019 on an area of 6,418 km². This results in a population density of 325 inhabitants per km². A list of 31 high-rise buildings is available. The buildings were handed over to their intended purpose between 1976 and 2025. The high-rise buildings have a height of between 100 m and 249 m.

The buildings count between 17 and 53 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.26-1) shows that 77% of the buildings are located in the interval of 101 to 150 m. The Top 2 office buildings and residential buildings can be found.

Table 4.26-1: Distribution of high-rise buildings by type of use and building height in Perth (Australia).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	0.0	9.7	0.0	0.0	**9.7**
Mixed use	0.0	0.0	6.5	0.0	0.0	**6.5**
Office	0.0	0.0	38.7	3.2	9.7	**51.6**
Residential	0.0	6.5	19.4	3.2	0.0	**29.0**
Telecommunications	0.0	0.0	3.2	0.0	0.0	**3.2**
Sum, %	**0.0**	**6.5**	**77.4**	**6.5**	**9.7**	**100.0**

Table 4.26-2: Distribution of high-rise buildings by type of use and number of floors in Perth (Australia).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	0.0	9.7	0.0	0.0	**9.7**
Mixed use	0.0	0.0	3.2	3.2	0.0	**6.5**
Office	0.0	0.0	22.6	25.8	3.2	**51.6**
Residential	0.0	0.0	3.2	22.6	3.2	**29.0**
Telecommunications	0.0	3.2	0.0	0.0	0.0	**3.2**
Sum, %	**0.0**	**3.2**	**38.7**	**51.6**	**6.5**	**100.0**

Table 4.26-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 52% of all buildings have 31 to 50 floors, and 39% have 21 to 30 floors. These are mainly office and residential buildings.

4.27 San Francisco (USA)

San Francisco was founded in 1776; the city is home to about 808,.900 inhabitants in 2023 on a land area of 121 km². This results in a population density of 6,686 inhabitants per km². A list of 59 high-rise buildings is available. The buildings were handed over to their intended purpose between 1925 and 2020. The high-rise buildings have a height of between 122 m and 326 m. The buildings count between 26 and 61 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.27-1) shows that 58% of the buildings are located in the interval of 101 to 150 m. More than 32% can be found in intervals 151 to 200 m. The Top 2 office buildings and residential buildings can be found.

Table 4.27-1: Distribution of high-rise buildings by type of use and building height in San Francisco (USA).

Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Hotel	0.0	0.0	3.4	0.0	0.0	**3.4**
Hotel, Office	0.0	0.0	0.0	0.0	1.7	**1.7**
Hotel, Residential	0.0	0.0	1.7	0.0	0.0	**1.7**
Office	1.7	0.0	33.9	22.0	5.1	**62.7**
Office, Residential	0.0	0.0	0.0	1.7	1.7	**3.4**
Residential	0.0	0.0	18.6	6.8	0.0	**25.4**
Residential, Museum	0.0	0.0	0.0	1.7	0.0	**1.7**
Sum, %	**1.7**	**0.0**	**57.6**	**32.2**	**8.5**	**100.0**

Table 4.27-2: Distribution of high-rise buildings by type of use and number of floors in San Francisco (USA).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Hotel	0.0	0.0	0.0	3.4	0.0	**3.4**
Hotel, Office	0.0	0.0	0.0	1.7	0.0	**1.7**
Hotel, Residential	0.0	0.0	0.0	1.7	0.0	**1.7**
Office	0.0	0.0	13.6	45.8	3.4	**62.7**
Office, Residential	0.0	0.0	0.0	1.7	1.7	**3.4**
Residential	0.0	0.0	1.7	18.6	5.1	**25.4**
Residential, Museum	0.0	0.0	0.0	1.7	0.0	**1.7**
Sum, %	**0.0**	**0.0**	**15.3**	**74.6**	**10.2**	**100.0**

Table 4.27-2 illustrates the distribution of high-rise buildings by type of use and number of floors. Seventy five percent of all buildings have 31 to 50 floors, and 15% have 21 to 30 floors. These are mainly office and residential buildings.

4.28 Shanghai (China)

Shanghai has an area of 6,340 km². Of these, 1,928 km² (30.4%) belong to the core city and the inner suburbs, and 4,412 km² (69.6%) consist of outer suburbs and areas with a rural settlement structure. Currently, 24,870,000 (2020) inhabitants live in the city. The population density is 3,922 inhabitants per km².

For high-rise buildings, we only have data from the Shanghai Statistical Yearbook (Table 4.28-1).

Table 4.28-1: Distribution of high-rise buildings by number of floors and years in Shanghai (China).

Number of Floors	2000	2007	2008	2009	2010	2015	2018	2019	2020	2021	2022
8 to 10	536	1.658	2.028	2.369	2.744	5.568	6.919	7.208	7.569	7.923	8.218
11 to 15	684	5.515	6.978	8.992	9.672	18.302	20.436	20.967	21.543	22.204	22.879
16 to 19	831	2.739	3.493	3.995	4.247	10.046	12.391	13.087	13.792	14.665	15.287
20 to 29	1.266	2.426	2.763	2.852	2.936	5.337	6.106	6.325	6.517	6.811	7.061
30 and more	212	777	847	975	980	1.569	1.703	1.765	1.820	1.864	1.913
Total	**3.529**	**13.115**	**16.109**	**19.183**	**20.579**	**40.822**	**47.555**	**49.352**	**51.241**	**53.467**	**55.358**

Table 4.28-1 covers the years from 2000 to 2022. The number of buildings is divided according to the respective number of floors.

4.29 Sofia (Bulgaria)

Sofia's population was about 1,190,300 in 2022. The city has an area of 492 km^2, which results in a population density of 2,419 inhabitants per km^2. A list of 40 high-rise buildings is available. The buildings were handed over to their intended purpose between 1956 and 2024. The high-rise buildings have a height of between 50 m and 126 m. The buildings count between 14 and 32 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.29-1) shows that 85% of the buildings are located in the interval of 51-100 m. In the Top three, office buildings, residential buildings, and hotels can be found.

Table 4.29-1: Distribution of high-rise buildings by type of use and building height in Sofia (Bulgaria).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Hotel	0.0	10.0	5.0	0.0	0.0	**15.0**
Office	2.5	35.0	7.5	0.0	0.0	**45.0**
Office, Hotel	0.0	2.5	0.0	0.0	0.0	**2.5**
Residential	0.0	37.5	0.0	0.0	0.0	**37.5**
Sum, %	**2.5**	**85.0**	**12.5**	**0.0**	**0.0**	**100.0**

Table 4.29-2: Distribution of high-rise buildings by type of use and number of floors in Sofia (Bulgaria).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Hotel	0.0	5.0	7.5	2.5	0.0	**15.0**
Office	0.0	35.0	10.0	0.0	0.0	**45.0**
Office, Hotel	0.0	0.0	2.5	0.0	0.0	**2.5**
Residential	0.0	5.0	32.5	0.0	0.0	**37.5**
Sum, %	**0.0**	**45.0**	**52.5**	**2.5**	**0.0**	**100.0**

Table 4.29-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 52% of all buildings have 21 to 30 floors. Then 45% have 11 to 20 floors. These are mainly office buildings, residential buildings, and hotels.

4.30 Taipei (Taiwan)

The first settlement was noted in 1709. The population is estimated at 2,494,000 (2023). The city area is 271.8 km^2, which results in a population density of 9,176 people per km^2. A list of 56 high-rise buildings is available. The buildings were handed over to their intended purpose between 1988 and 2025. The high-rise buildings have a height of between 140 m and 508 m and 25 to 101 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.30-1) shows that 54% of the buildings are located in the interval of 151-200 m. In the Top 2, residential and office buildings can be found.

Table 4.30-1: Distribution of high-rise buildings by type of use and building height in Taipei (Taiwan).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Government	0.0	0.0	1.8	0.0	0.0	**1.8**
Hotel	0.0	0.0	5.4	3.6	1.8	**10.7**
Mixed	0.0	0.0	1.8	10.7	1.8	**14.3**
Office	0.0	0.0	5.4	14.3	10.7	**30.4**
Residential	0.0	0.0	17.9	25.0	0.0	**42.9**
Sum, %	**0.0**	**0.0**	**32.1**	**53.6**	**14.3**	**100.0**

Table 4.30-2: Distribution of high-rise buildings by type of use and number of floors in Taipei (Taiwan).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Government	0.0	0.0	0.0	1.8	0.0	**1.8**
Hotel	0.0	0.0	1.8	7.1	1.8	**10.7**
Mixed	0.0	0.0	0.0	14.3	0.0	**14.3**
Office	0.0	0.0	3.6	21.4	5.4	**30.4**
Residential	0.0	0.0	0.0	42.9	0.0	**42.9**
Sum, %	**0.0**	**0.0**	**5.4**	**87.5**	**7.1**	**100.0**

Table 4.30-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 87% of all buildings have 31 to 50 floors. These are mainly residential buildings and office buildings.

Below, we look at information from the Taipei Statistical Yearbook regarding the structure of the building.[134]

[134] Taipei City Statistical Yearbook 2024, Department of Budget, Accounting and Statistics, Taipei City Government.

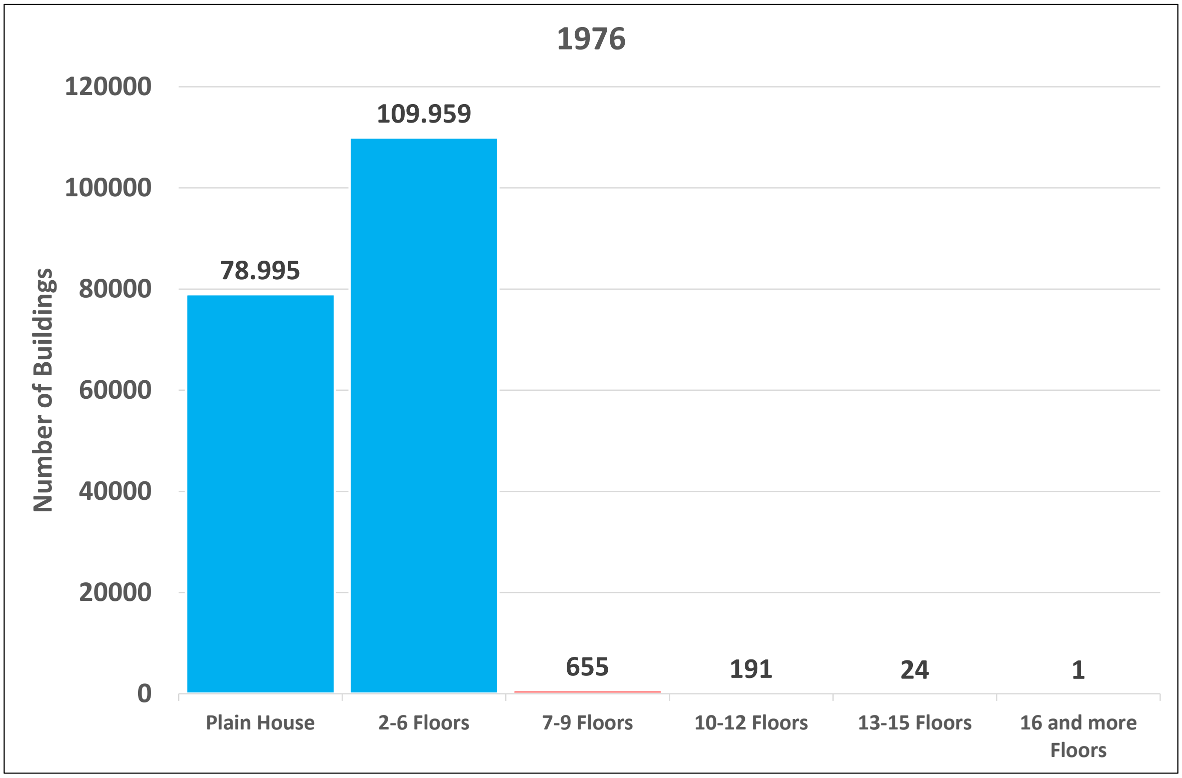


Figure 4.30-1: Distribution of buildings by number of floors height in Taipei (Taiwan) as for 1976.

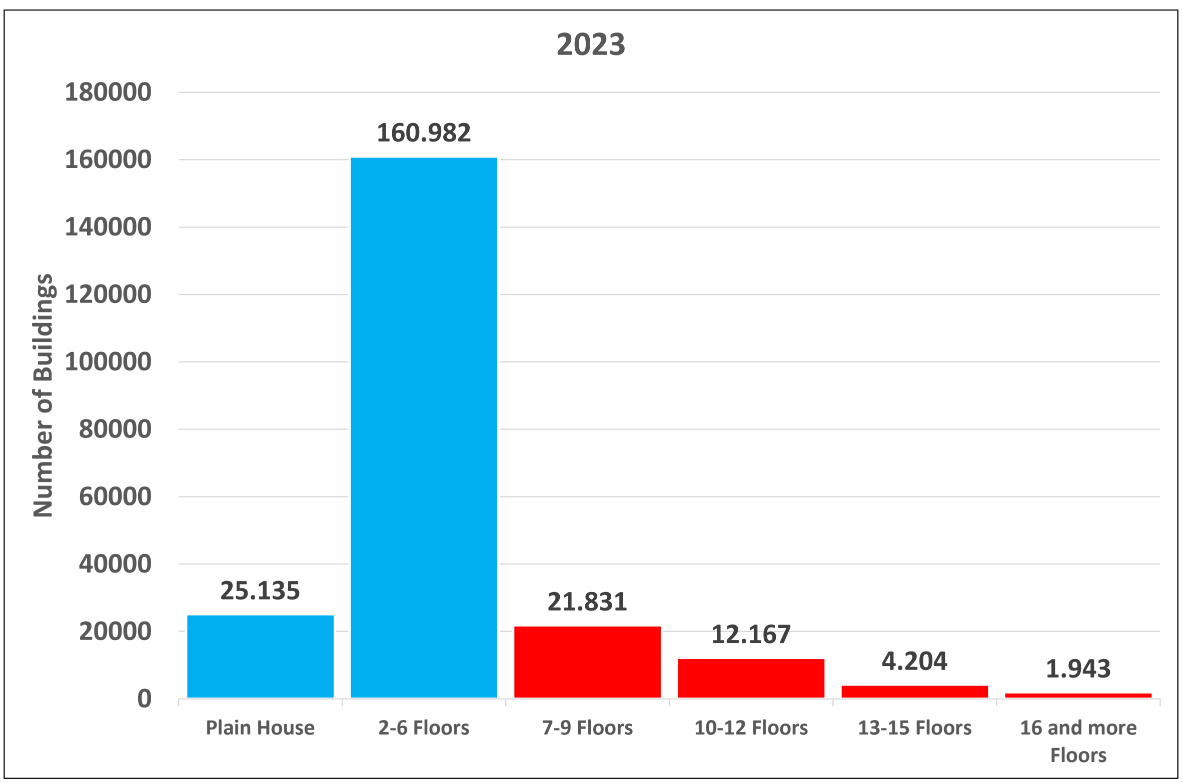


Figure 4.30-2: Distribution of buildings by number of floors height in Taipei (Taiwan) as for 2023.

In 1976, 189,825 buildings were counted in the city. Of these, 78,995 (41.6%) were plain houses, and 109,959 buildings had two to six stories (57.9%). The remaining 871 buildings (0.5%) had seven or more stories. In the entire city, there was only 1 building with 16 or more floors (Figure 4.30-1).

In 2023, 226,262 buildings were counted in the city. Of these, 25,135 (11.1%) were plain houses, and 160,982 buildings had two to six stories (71.1%). The remaining 40145 buildings (17.8%) had seven or more stories. There were 1,943 buildings with 16 or more floors throughout the city (Figure 4.30-2).

4.31 Tel Aviv (Israel)

The town was founded in 1909; the city is home to about 474,530 inhabitants in 2022 on an area of 52 km². This results in a population density of 9,126 inhabitants per km². A list of 68 high-rise buildings is available. The buildings were handed over to their intended purpose between 1965 and 2025. The high-rise buildings have a height of between 102 m and 238 m. The buildings count between 17 and 54 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.31-1) shows that 68% of the buildings are located in the interval of 101 to 150 m. More than 31% of the high-rise buildings are located in the interval of 151 to 200 m. The top 2 residential buildings and office buildings can be found here.

Table 4-31-1: Distribution of high-rise buildings by type of use and building height in Tel Aviv (Israel).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Government	0.0	0.0	2.9	0.0	0.0	**2.9**
Hotel / Office	0.0	0.0	1.5	0.0	0.0	**1.5**
Hotel / Residential	0.0	0.0	1.5	0.0	0.0	**1.5**
Office	0.0	0.0	19.1	14.7	1.5	**35.3**
Office / Government	0.0	0.0	0.0	1.5	0.0	**1.5**
Residential	0.0	0.0	38.2	5.9	0.0	**44.1**
Residential / Hotel	0.0	0.0	1.5	0.0	0.0	**1.5**
Residential / Office	0.0	0.0	2.9	8.8	0.0	**11.8**
Sum, %	**0.0**	**0.0**	**67.6**	**30.9**	**1.5**	**100.0**

Table 4-31-2: Distribution of high-rise buildings by type of use and number of floors in Tel Aviv (Israel).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Government	0.0	2.9	0.0	0.0	0.0	**2.9**
Hotel / Office	0.0	0.0	1.5	0.0	0.0	**1.5**
Hotel / Residential	0.0	0.0	0.0	1.5	0.0	**1.5**
Office	0.0	0.0	5.9	27.9	1.5	**35.3**
Office / Government	0.0	0.0	0.0	1.5	0.0	**1.5**
Residential	0.0	0.0	11.8	32.4	0.0	**44.1**
Residential / Hotel	0.0	0.0	1.5	0.0	0.0	**1.5**
Residential / Office	0.0	0.0	0.0	10.3	1.5	**11.8**
Sum, %	**0.0**	**2.9**	**20.6**	**73.5**	**2.9**	**100.0**

Table 4.31-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 74% of all buildings have 31 to 50 floors. These are mainly residential buildings and office buildings.

4.32 Tokyo (Japan)

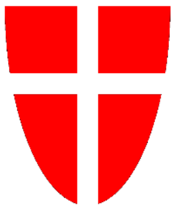
The city's history begins in 1446 when Ōta Dōkan began building Edo Castle in a swamp area on the north shore of present-day Tokyo Bay, surrounded by a few fishing villages.

The Tokyo metropolitan area covers an area of 13,573 km^2. 38.5 million people live there (2019). The population density is 2,827 inhabitants per km^2. Tokyo has a population of 9.6 million and covers an area of 628 km^2 (9,640 inhabitants per km^2). The Tokyo Statistical Yearbook presents an overview of the number of building floors for 2022 (Figure 4.32-1).

Fig. 4.32-1: Distribution of buildings by number of floors (Tokyo, 2022).

Floors	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13-29**	**≥30**	**Total**
Buildings	54.737	43.439	19.855	15.436	12.719	9.811	8.245	4.573	3.403	7.671	382	**180.271**
%	30.4	24.1	11.0	8.6	7.1	5.4	4.6	2.5	1.9	4.3	0.2	**100**

4.33 Vienna (Austria)



Vienna has been called the "City of Music" due to its musical legacy, as many famous classical musicians such as Beethoven, Brahms, Bruckner, Haydn, Mahler, Mozart, Schoenberg, Schubert, Johann Strauss I and Johann Strauss II lived and worked in the town. By population, Vienna ranked 10th in Europe and 1st in Austria. Vienna has a population of about 2,028,500 in 2025. The city manages an area of 415 km^2; this results in a population density of 5,120 inhabitants per km^2. A list of 59 high-rise buildings is available. The buildings were handed over to their intended purpose between 1955 and 2024. The high-rise buildings have a height of between 33 m and 250 m. The buildings count between 17 and 60 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.33-1) shows that 58% of the buildings are located in the interval of 51-100 m. Some 34% of the high-rises are located in the interval of 101-150 m. In the Top 2, office and residential buildings can be found.

Table 4.33-1: Distribution of high-rise buildings by type of use and building height in Vienna (Austria).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Offices	0.0	28.8	13.6	1.7	3.4	**47.5**
Hotel	0.0	3.4	0.0	0.0	0.0	**3.4**
Hospital	0.0	1.7	0.0	0.0	0.0	**1.7**
Dormitory	0.0	0.0	1.7	0.0	0.0	**1.7**
Residential	1.7	23.7	18.6	1.7	0.0	**45.8**
Sum, %	**1.7**	**57.6**	**33.9**	**3.4**	**3.4**	**100.0**

Table 4.33-2: Distribution of high-rise buildings by type of use and number of floors in Vienna (Austria).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Offices	0.0	6.8	28.8	10.2	1.7	**47.5**
Hotel	0.0	3.4	0.0	0.0	0.0	**3.4**
Hospital	0.0	0.0	1.7	0.0	0.0	**1.7**
Dormitory	0.0	0.0	0.0	1.7	0.0	**1.7**
Residential	0.0	0.0	22.0	23.7	0.0	**45.8**
Sum, %	**0.0**	**10.2**	**52.5**	**35.6**	**1.7**	**100.0**

Table 4.33-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 53% of all buildings have 21 to 30 floors. Some more 36% of the buildings have of 31 to 50 floors. These are mainly office buildings and residential buildings.

4.34 Wellington (New Zealand)

The town was founded in 1839; the city is home to about 213,100 inhabitants in 2022 on an area of 290 km². This results in a population density of 735 inhabitants per km². A list of 61 high-rise buildings is available. The buildings were handed over to their intended purpose between 1963 and 2023. The high-rise buildings have a height of between 50 m and 116 m. The buildings count between 10 and 29 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.34-1) shows that 69% of the buildings are located in the interval of 51 to 100 m, and 26% of the high-rise buildings are located in the interval up to 50 m. In the Top 2, office buildings and residential buildings can be found.

Table 4.34-1: Distribution of high-rise buildings by type of use and building height in Wellington (New Zealand).

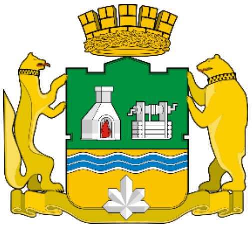
Height, m	≤50	51-100	101-150	151-200	>200	Sum, %
Commercial	0.0	3.3	0.0	0.0	0.0	**3.3**
Hotel	0.0	6.6	0.0	0.0	0.0	**6.6**
Hotel/Office	0.0	1.6	0.0	0.0	0.0	**1.6**
Office	23.0	49.2	4.9	0.0	0.0	**77.0**
Office/Residential	0.0	1.6	0.0	0.0	0.0	**1.6**
Residential	3.3	6.6	0.0	0.0	0.0	**9.8**
Sum, %	**26.2**	**68.9**	**4.9**	**0.0**	**0.0**	**100.0**

Table 4.34-2: Distribution of high-rise buildings by type of use and number of floors in Wellington (New Zealand).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Commercial	0.0	3.3	0.0	0.0	0.0	**3.3**
Hotel	0.0	4.9	1.6	0.0	0.0	**6.6**
Hotel/Office	0.0	0.0	1.6	0.0	0.0	**1.6**
Office	1.6	63.9	11.5	0.0	0.0	**77.0**
Office/Residential	0.0	1.6	0.0	0.0	0.0	**1.6**
Residential	0.0	9.8	0.0	0.0	0.0	**9.8**
Sum, %	**1.6**	**83.6**	**14.8**	**0.0**	**0.0**	**100.0**

Table 4.34-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 84% of all buildings have 11 to 20 floors. Some more 15% of the buildings have of 21 to 30 floors. These are mainly office buildings and residential buildings.

4.35 Yekaterinburg (Russia)



Yekaterinburg was founded in 1723 and named after the Orthodox name of Catherine I (born Marta Helena Skowrońska), the wife of Russian Emperor Peter the Great. The city is located on the Iset River between the Volga-Ural region and Siberia, with 1,536,000 residents (2024). The town manages an area of 1,110 km^2; this results in a population density of 1,200 inhabitants per km^2. A list of 68 high-rise buildings is available. The high-rise buildings have a height of between 92 m and 213 m. The buildings count between 20 and 52 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.35-1) shows that 68% of the buildings are located in the interval of 51-100 m. Some more than 28% of the buildings are located in the interval of 101 to 150 m. The top 2 residential buildings and office buildings can be found here.

Table 4.35-1: Distribution of high-rise buildings by type of use and building height in Yekaterinburg (Russia).

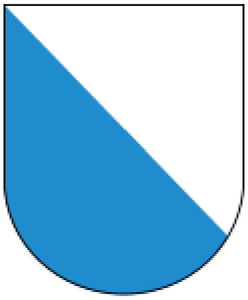
Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Mixed use	0.0	1.5	0.0	0.0	0.0	**1.5**
Offices	0.0	4.4	1.5	1.5	1.5	**8.8**
Residential	0.0	61.8	26.5	0.0	0.0	**88.2**
Trade	0.0	0.0	0.0	1.5	0.0	**1.5**
Sum, %	**0.0**	**67.6**	**27.9**	**2.9**	**1.5**	**100.0**

Table 4.35-2: Distribution of high-rise buildings by type of use and number of floors in Yekaterinburg (Russia).

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum, %**
Mixed use	0.0	0.0	1.5	0.0	0.0	**1.5**
Offices	0.0	1.5	2.9	2.9	1.5	**8.8**
Residential	0.0	0.0	13.2	75.0	0.0	**88.2**
Trade	0.0	0.0	0.0	1.5	0.0	**1.5**
Sum, %	**0.0**	**1.5**	**17.6**	**79.4**	**1.5**	**100.0**

Table 4.35-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 79% of all buildings have 31 to 50 floors, and 18% have 21 to 30 floors. These are mainly residential and office buildings.

4.36 Zurich (Switzerland)



Historically, Zurich is an ancient settlement that lived from trade during the Roman Empire. However, it was not until the incorporation of some suburbs in 1893 that the city of Zurich received its current political structure. With the merger, the area of the city grew from around 1.8 to a good 48 km². Zurich reached its current extent, almost twice as large, with the second incorporation in 1934. The municipal area of the city of Zurich currently covers an area of 87.9 km², with a further 3.95 km² on Lake Zurich. At the end of 2023, the city had a population of 433,989. According to this, the population density is 4,936 people per km². A list of 71 high-rise buildings is available. The buildings were handed over to their intended purpose between 1894 and 2025. The high-rise buildings have a height of between 50 m and 126 m. The buildings count between 7 and 36 floors. Other high-rise buildings are located in the city outside the intervals described. The analysis of the distribution of high-rise buildings by type of use and building height (Table 4.36-1) shows that 95% of the buildings are located in the interval of 51-100 m. In the Top 2, office and residential buildings can be found.

Table 4.36-1: Distribution of high-rise buildings by type of use and building height in Zurich (Switzerland).

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum, %**
Office	2.8	26.8	0.0	0.0	0.0	**29.6**
Office/Restaurant	0.0	0.0	1.4	0.0	0.0	**1.4**
Office/Residential	0.0	1.4	0.0	0.0	0.0	**1.4**
University	0.0	2.8	0.0	0.0	0.0	**2.8**
University/ Residential	0.0	1.4	0.0	0.0	0.0	**1.4**
Hotel	0.0	1.4	0.0	0.0	0.0	**1.4**
Hotel/ Residential	0.0	2.8	0.0	0.0	0.0	**2.8**
Hospital	0.0	4.2	0.0	0.0	0.0	**4.2**
Museum	0.0	1.4	0.0	0.0	0.0	**1.4**
Observatory	0.0	1.4	0.0	0.0	0.0	**1.4**
Residential	1.4	49.3	0.0	0.0	0.0	**50.7**
Residential /Office	0.0	1.4	0.0	0.0	0.0	**1.4**
Sum, %	**4.2**	**94.4**	**1.4**	**0.0**	**0.0**	**100.0**

Table 4.36-2: Distribution of high-rise buildings by type of use and number of floors in Zurich (Switzerland).

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum, %
Office	0.0	22.5	5.6	1.4	0.0	**29.6**
Office/Restaurant	0.0	0.0	0.0	1.4	0.0	**1.4**
Office/Residential	0.0	0.0	1.4	0.0	0.0	**1.4**
University	1.4	1.4	0.0	0.0	0.0	**2.8**
University/ Residential	0.0	0.0	1.4	0.0	0.0	**1.4**
Hotel	0.0	1.4	0.0	0.0	0.0	**1.4**
Hotel/ Residential	0.0	0.0	2.8	0.0	0.0	**2.8**
Hospital	0.0	4.2	0.0	0.0	0.0	**4.2**
Museum	1.4	0.0	0.0	0.0	0.0	**1.4**
Observatory	1.4	0.0	0.0	0.0	0.0	**1.4**
Residential	0.0	32.4	15.5	2.8	0.0	**50.7**
Residential /Office	0.0	0.0	1.4	0.0	0.0	**1.4**
Sum, %	**4.2**	**62.0**	**28.2**	**5.6**	**0.0**	**100.0**

Table 4.36-2 illustrates the distribution of high-rise buildings by type of use and number of floors. 62% of all buildings have 11 to 20 floors, and 28% have 21 to 30 floors. These are mainly residential and office buildings.

4.37 High-rise Buildings by Use – some Summary

In the lists of high-rise buildings considered in Section 4, it is possible to determine the proportion of high-rise buildings with a **height of ">200 m"**. We find that the top 3 can be named as follows: New York City (USA) with 96.3%, Dubai (UAE) with 68.2%, and Jakarta (Indonesia) with 55.7%. At the other end of the overview, several cities either have a tiny proportion or no buildings of this height have been erected at all (Table 4.37-1).

If we look at the interval **"151-200 m"**, the top 3 for this building height can be found in the following cities: Taipei (Taiwan) with 53.6%, Mumbai (India) with 55.7%, and Istanbul (Türkiye) with 61.1% (Table 4.37-1). Now, let's look at the height of the buildings at an interval from 101 to 150 m. The top 3 of all cities surveyed are Karachi (Pakistan) with 77.8%, Perth (Australia) with 77.4%, and Buenos Aires (Argentina) with 75.6% (Table 4.37-1).

The following conclusions can be drawn from Table 4.37-2 in general terms:

- The top three cities surveyed here in terms of the highest proportion of **office high-rises** are Wellington (New Zealand) with 80.3%, Johannesburg (South Africa) with 66.7%, and San Francisco (USA) with 62.7%. The lowest proportion of office high-rises is then in Yekaterinburg (Russia) with 8.8%, Mumbai (India) with 6.7%, and Chennai (India) with 5.5%.
- The top three cities surveyed here in terms of the highest proportion of **hotel high-rise buildings** are Amman (Jordan) with 41,7%, Dubai (UAE) with 16,5%, and Sofia (Bulgaria) with 15,0%. The lowest proportion of hotel high-rises is then in Jakarta (Indonesia) with 1,1%, Panama City (Panama) with 1,1%, and Hong Kong (China) with 0,6%.
- The top three cities surveyed here in terms of the highest proportion of **residential high-rise buildings** are Yekaterinburg (Russia) with 88,2%, Mumbai (India) with 88,9%, and Chennai (India) with 94,5%. The lowest proportion of hotel high-rises is then in Dhaka (Bangladesh) with 8,2%, Amman (Jordan) with 8,3%, and Wellington (New Zealand) with 9,8%.
- The top 3 of all cities surveyed here in terms of the highest proportion of **other or mixed-use high-rise buildings** are Adelaide (Australia) with 30,0%, Cape Town (South Africa) with 30,0%, and Hanoi (Vietnam) with 59,7%. The lowest proportion of high-rise buildings (other or mixed use) is then in Mumbai (India) with 0,1%, Sofia (Bulgaria) with 2,5%, and Buenos Aires (Argentina) with 2,5%.
- The top three cities surveyed here in terms of the highest **number of floors in the high-rise buildings in the interval ">50 floors"** are New York City (USA) with 83,5%, Hong Kong (China) with 75,1%, and Dubai (UAE) with 68,2%.
- The top three cities surveyed here in terms of the highest **number of floors in high-rise buildings in the interval "31 to 50 floors"** are Delhi (NCR, India) with 90,7%, Taipei (Taiwan) with 87,5%, and Paris (France) with 81,7%.
- The top three cities surveyed here in terms of the highest **number of floors in high-rise buildings in the interval "21 to 30 floors"** are Madrid (Spain) with 70,6%, Cape Town (South Africa) with 70%, and Karachi (Pakistan)with 59,3%.

Some notes follow Tables 4.37-1 and 4.37-2 below.

Table 4.37-1: Distribution of high-rise buildings by population density, height, and number of buildings examinate.

City (Country)	Persons per km²	Share of buildings (%) by building height (m)					Number of buildings
		≤50 m	51-100 m	101-150 m	151-200 m	>200 m	
Adelaide (Australia)	420	0.0	78.0	22.0	0.0	0.0	50
Amman (Jordan)	2,887	0.0	75.0	16.7	8.3	0.0	24
Basel (Switzerland)	7,393	0.0	89.7	5.1	2.6	2.6	39
Berlin (Germany)	4,110	3.9	92.2	3.9	0.0	0.0	205
Buenos Aires (Argentina)	15,161	0.0	11.0	75.6	12.2	1.2	82
Cape Town (South Africa)	1,083	0.0	50.0	50.0	0.0	0.0	20
Chennai (India)	26,700	0.0	59.3	38.5	2.2	0.0	91
Delhi (NCR, India)	11,300	0.0	0.0	55.6	42.6	1.9	54
Dhaka (Bangladesh)	33,645	0.0	85.2	9.8	3.3	1.6	62
Dubai (UAE)	898	0.6	1.2	5.9	24.1	68.2	170
Frankfurt Main (Germany)	3,019	3.9	64.1	16.4	12.5	3.1	128
Greater Manchester (UK)	2,282	6.6	81.1	8.7	3.1	0.5	196
Hong Kong (China)	6,890	0.0	0.0	0.0	52.6	47.4	173
Istanbul (Türkiye)	3,035	0.0	0.0	22.2	61.1	16.7	72
Jakarta (Indonesia)	15,966	0.0	0.0	0.0	44.3	55.7	88
Johannesburg (RSA)	2,920	0.0	14.3	61.9	14.3	9.5	21
Karachi (Pakistan)	5,779	0.0	7.4	77.8	11.1	3.7	27
London (UK)	5,597	0.0	3.3	65.0	22.8	8.9	127
Madrid (Spain)	5,640	0.0	58.8	23.5	5.9	11.8	34
Mexico-City (Mexico)	6,160	0.0	0.0	49.0	39.2	11.8	51
Mumbai (India)	25,546	0.0	0.0	16.6	55.7	27.7	253
New York City (USA)	11,153	0.0	0.0	0.0	3.7	96.3	109
Panama-City (Panama)	275	0.0	1.1	24.4	46.7	27.8	90
Paris (France)	20,054	0.0	8.5	63.4	24.4	3.7	82
Perth (Australia)	325	0.0	6.5	77.4	6.5	9.7	31
San Francisco (USA)	6,686	1.7	0.0	57.6	32.2	8.5	59
Sofia (Bulgaria)	2,419	2.5	85.0	12.5	0.0	0.0	40
Taipei (Taiwan)	9,176	0.0	0.0	32.1	53.6	14.3	56
Tel Aviv (Israel)	9,126	0.0	0.0	67.6	30.9	1.5	68
Vienna (Austria)	5,120	1.7	57.6	33.9	3.4	3.4	59
Wellington (New Zealand)	735	26.2	68.9	4.9	0.0	0.0	61
Yekaterinburg (Russia)	1,200	0.0	67.6	27.9	2.9	1.5	68
Zurich (Switzerland)	4,936	4.2	94.4	1.4	0.0	0.0	71

Table 4.37-2: Distribution of high-rise buildings by main type of use, and number of floors.

City (Country)	Main Type of Use (%)				Number of Floors, intervals (%)				
	Commercial, offices	Hotel	Residential	Other, mixed use	≤10	11-20	21-30	31-50	>50
Adelaide (Australia)	42.0	10.0	18.0	30.0	0.0	42.0	40.0	14.0	0.0
Amman (Jordan)	37.5	41.7	8.3	12.5	0.0	58.3	16.7	25.0	0.0
Basel (Switzerland)	46.2	-	33.3	20.5	7.7	74.4	10.3	7.7	0.0
Berlin (Germany)	19.0	4.4	64.4	12.2	1.5	60.0	36.6	2.0	0.0
Buenos Aires (Argentina)	28.0	-	69.5	2.5	0.0	1.2	25.6	69.5	3.7
Cape Town (South Africa)	35.0	10.0	25.0	30.0	0.0	10.0	70.0	20.0	0.0
Chennai (India)	5.5	-	94.5	0.0	0.0	53.8	37.4	8.8	0.0
Delhi (NCR, India)	14.9	-	85.2	0.0	0.0	0.0	3.7	90.7	5.6
Dhaka (Bangladesh)	59.0	13.1	8.2	19.7	0.0	42.6	49.2	8.2	0.0
Dubai (UAE)	10.6	16.5	60.0	12.9	0.6	1.2	5.9	24.1	68.2
Frankfurt Main (Germany)	57.0	5.5	21.9	15.6	0.0	50.0	25.8	19.5	4.7
Greater Manchester (UK)	16.3	6.1	65.3	12.3	2.0	55.6	28.6	11.7	2.0
Hanoi (Vietnam)	-	-	40.3	59.7	-	-	-	-	-
Hong Kong (China)	22.5	0.6	69.9	7.0	0.0	0.0	0.0	24.9	75.1
Istanbul (Türkiye)	25.0	2.8	45.8	26.4	0.0	0.0	1.4	79.2	19.4
Jakarta (Indonesia)	45.5	1.1	35.2	18.2	0.0	0.0	0.0	70.5	29.5
Johannesburg (South Africa)	66.7	9.5	19.0	4.8	0.0	4.8	47.6	38.1	9.5
Karachi (Pakistan)	44.4	-	37.0	18.6	0.0	3.7	59.3	33.3	3.7
London (UK)	28.5	2.4	61.0	8.1	2.4	0.8	15.4	68.3	13.0
Madrid (Spain)	47.1	-	35.3	17.6	0.0	5.9	70.6	14.7	8.8
Mexico-City (Mexico)	45.1	5.9	35.3	13.7	0.0	0.0	17.6	66.7	15.7
Mumbai (India)	6.7	4.3	88.9	0.1	0.0	0.0	0.4	56.5	43.1
New York City (USA)	49.5	1.8	33.9	14.8	0.0	0.0	0.0	16.5	83.5
Panama-City (Panama)	11.1	1.1	78.9	8.9	0.0	0.0	3.3	55.6	41.1
Paris (France)	56.1	3.7	32.9	7.3	0.0	0.0	17.1	81.7	1.2
Perth (Australia)	51.6	9.7	29.0	9.7	0.0	3.2	38.7	51.6	6.5
San Francisco (USA)	62.7	3.4	25.4	8.5	0.0	0.0	15.3	74.6	10.2
Sofia (Bulgaria)	45.0	15.0	37.5	2.5	0.0	45.0	52.5	2.5	0.0
Taipei (Taiwan)	30.4	10.7	42.9	16.0	0.0	0.0	5.4	87.5	7.1
Tel Aviv (Israel)	35.3	-	44.1	20.6	0.0	2.9	20.6	73.5	2.9
Vienna (Austria)	47.5	3.4	45.8	3.3	0.0	10.2	52.5	35.6	1.7
Wellington (New Zealand)	80.3	6.6	9.8	3.3	1.6	83.6	14.8	0.0	0.0
Yekaterinburg (Russia)	8.8	-	88.2	3.0	0.0	1.5	17.6	79.4	1.5
Zurich (Switzerland)	29.6	1.4	50.7	18.3	4.2	62.0	28.2	5.6	0.0

Resumé:
What is the widespread opinion regarding the raison d'être of modern high-rise buildings?

- High-rise buildings are being built to create more residential and office space in a small ground area.
- High-rise buildings are intended to represent efficient land use and offer excellent views.
- High-rise buildings are also intended to provide a sense of security and privacy compared to other types of buildings from a different point of view.
- High-rise buildings have modern technologies (heating, cooling, ventilation, elevators, electrical systems, communication systems, waste management).
- High-rise buildings offer short distances to reach comfort zones (shops, services, workplaces, etc.).

Tables 4.37-1 and 4.37-2 show that high-rise buildings represent a global phenomenon. The need for modern housing, efficient workplaces for management/administration/services, and special types of use (e.g., hotels and hospitals) drive national and international competition for planners, architects, administrations, and investors.

5.0 Hospital as High-rise Building

An international list of 29 buildings is available to consider high-rise buildings used as hospitals. The buildings are spread over 13 countries. The high-rise buildings were handed over to their use in 1974-2019. The buildings have 21 to 50 floors. The height of the building varies between 82 and 191 m. From this information, it can be seen that these are only the tallest buildings of this type. The TOP3 are distributed among the USA (11 buildings), China (6 buildings), and Brazil (3 buildings).

Table 5.0-1: Distribution of high-rise buildings used as hospitals by building height in selected cities.

Height, m	≤50	51-100	101-150	151-200	>200	Sum	%
Amman	0	0	1	0	0	**1**	**3,4**
Bangkok	0	0	1	0	0	**1**	**3,4**
Berlin	0	1	0	0	0	**1**	**3,4**
Chicago	0	0	3	0	0	**3**	**10,3**
Chongqing	0	0	1	0	0	**1**	**3,4**
Goiânia	0	0	0	1	0	**1**	**3,4**
Herlev	0	0	1	0	0	**1**	**3,4**
Hong Kong	0	0	2	0	0	**2**	**6,9**
Houston	0	0	3	2	0	**5**	**17,2**
London	0	0	1	0	0	**1**	**3,4**
Monterrey	0	0	1	0	0	**1**	**3,4**
New York City	0	0	2	1	0	**3**	**10,3**
Riyadh	0	0	1	0	0	**1**	**3,4**
São Paulo	0	0	2	0	0	**2**	**6,9**
Shanghai	0	0	0	1	0	**1**	**3,4**
Taichung	0	0	1	0	0	**1**	**3,4**
Tokyo	0	0	1	0	0	**1**	**3,4**
Wuhan	0	0	2	0	0	**2**	**6,9**
Sum	**0**	**1**	**23**	**5**	**0**	**29**	**100.0**
%	**0.0**	**3.4**	**79.3**	**17.2**	**0.0**		**100.0**

Due to the lack of data, no statistical trends can be derived from Tables 5.0-1 and 5.0-2. We can only note that hospitals in buildings with more than 50 m in height are also put into operation. In such buildings, increased dangers can generally be assumed. Figure 5.0-1 compiles the most essential dangers graphically. We have relied on figures, as there are no exhaustive statistics on the cities considered in this section.

Table 5.0-2: Distribution of high-rise buildings used as hospitals by number of floors in selected cities.

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum	%
Amman	0	0	0	1	0	**1**	**3.4**
Bangkok	0	0	1	0	0	**1**	**3.4**
Berlin	0	0	1	0	0	**1**	**3.4**
Chicago	0	0	3	0	0	**3**	**10.3**
Chongqing	0	0	1	0	0	**1**	**3.4**
Goiânia	0	0	0	1	0	**1**	**3.4**
Herlev	0	0	1	0	0	**1**	**3.4**
Hong Kong	0	0	1	1	0	**2**	**6.9**
Houston	0	0	4	1	0	**5**	**17.2**
London	0	0	0	1	0	**1**	**3.4**
Monterrey	0	0	1	0	0	**1**	**3.4**
New York City	0	0	2	1	0	**3**	**10.3**
Riyadh	0	0	1	0	0	**1**	**3.4**
São Paulo	0	0	2	0	0	**2**	**6.9**
Shanghai	0	0	0	1	0	**1**	**3.4**
Taichung	0	0	1	0	0	**1**	**3.4**
Tokyo	0	0	1	0	0	**1**	**3.4**
Wuhan	0	0	0	2	0	**2**	**6.9**
Sum	**0**	**0**	**20**	**9**	**0**	**29**	**100.0**
%	**0.0**	**0.0**	**69.0**	**31.0**	**0.0**	**100.0**	

The following textual notes may describe the fire hazards in hospitals.

Electrical equipment: Faulty electrical equipment is a common cause of hospital fires. To prevent these fires, hospitals should properly maintain all electrical equipment and check it regularly. Overloaded sockets and cables often cause fires if they are connected directly to a socket and not connected in series. Hospitals should install automatic shut-off devices on all electrical equipment. Hospitals help prevent fires by following simple safety guidelines. In this way, the hospitals ensure the safety of both patients and employees.

Kitchen facilities: Electrical appliances must never be left unattended in hospital kitchens. If edible fats are used, they must be disposed of properly. Good fire protection in hospital kitchens also means installing functioning smoke detectors. Furthermore, kitchenettes used with tea and coffee machines must also be inspected regularly.

Smoking: Cigarettes are a common cause of hospital fires, according to many national fire statistics. Although smoking is not allowed in hospitals, there are times when people smuggle it indoors or do not dispose of it properly when smoking outdoors. Cigarette fires in hospitals can be hazardous because patients often use tobacco products very irresponsibly. For this reason, there are the following recommendations: Properly disposing of cigarettes, not smoking indoors, and creating a “no smoking” policy for the entire facility.

Figure 5.0-1: The most important dangers in hospitals.

Gas cylinders and medical oxygen compliance: According to national fire statistics, hospital fires are often affected by gas cylinders and medical oxygen. While the causes of these fires vary, improper storage and securing of gas cylinders and medical oxygen are frequently to blame. The gas cylinders and medical oxygen must be stored appropriately and secured to prevent fires. For this reason, there are the following recommendations: Storage of gas cylinders and medical oxygen in well-ventilated areas; gas cylinders and medical oxygen must be secured in such a way that they cannot be knocked over, and gas cylinders and medical oxygen must be regularly inspected for leaks by trained specialists.

Anesthesia machines: Medical equipment is an essential tool in hospitals. However, these medical devices can also pose a significant fire risk due to the high concentration of oxygen they generate. Oxygen accelerates combustion, and any spark or heat source nearby can cause a fire. Maintaining these machines regularly and training staff to use them correctly is crucial. In addition, flammable materials must be kept away from anesthesia machines.

Inadequate fire training: The lack of proper fire safety training and fire awareness among hospital staff can lead to fires. In many cases, fires start small but become catastrophic because people don't know how to react or use fire extinguishers. Regular fire safety training and drills for all staff, especially night shift staff, must be mandatory in hospitals. The training must cover response in the event of a fire, the use of fire extinguishers, and the safe evacuation of patients.

Faulty and poorly maintained fire safety systems: A defective fire alarm or poorly maintained sprinkler system can significantly increase the risk of a fire spreading in a hospital. Regular maintenance and testing of fire protection systems, including alarm, fire extinguishing, and sprinkler systems, is crucial. A minor fire can quickly spiral out of control if these systems don't work correctly.

Specialized Medical Equipment: Due to the increasing equipment of hospitals with modern electrical equipment, there have been more and more hospital fires caused by special medical equipment for years. Due to their high energy output, lasers and electrosurgical devices are frequent ignition sources. There are also fires related to oxygen tanks, surgical clothing, and flammable sterilizing liquids. Wherever possible, these items should be stored in fireproof cabinets or containers.

Extension Cord Daisy Chains: Extension cords are standard in many hospitals and often chain different devices. However, using extension cords in this way violates hospital safety standards. Extension cords can overheat, posing a fire hazard. In addition, they can cause tripping hazards and may not provide enough power for some types of devices. Hospitals must avoid extension cords and use separate power lines for each device.

Storage of Combustible Materials: Improper storage of flammable materials such as paper, fabric, and plastics can lead to hospital fires. These materials must be stored in designated, safe, and fireproof areas, such as a properly maintained airlock room, away from heat or ignition sources. In addition, waste management concepts must be in place to ensure that these materials do not accumulate and pose a fire hazard.

Heating Equipment: Heaters, such as portable devices, are common causes of hospital fires. This is especially true for buildings exposed to winter climatic conditions. These devices must be protected from flammable materials and regularly checked and maintained. That is the only way to ensure that they function correctly. An automatic switch-off is also helpful if an appliance overheats or tips over. Control measures include staff training.

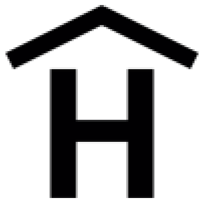
Hand Sanitizers: Alcohol-based hand sanitizers are often used in hospitals to prevent the spreading of infections. However, these products can be highly flammable and must be stored away from potential ignition sources. To avoid fire tragedies, hospitals should consider investing in non-flammable alternatives to alcohol-based products that provide the same level of protection without the same fire risk.

Resumé:

In several large cities, hospitals have been set up in high-rise buildings well over 50 m high. Due to external conditions, this trend is expected to continue.

It recommends that local and national administrations compile fire-relevant statistics, which serve as further findings in international comparison.

6.0 Hotel High-rise Buildings



An international list of 54 buildings is available to consider high-rise buildings used as hotels. The buildings are spread over 16 countries and were handed over to their use from 1957 to 2024. The buildings have 24 to 84 floors and a height between 200 and 374 m. From this information, it can be seen that these are only the tallest buildings of this type. The TOP3 are distributed among the United Arab Emirates, China, and the USA.

Table 6.0-1: Distribution of high-rise buildings used as hotel by building height in selected countries.

Height, m	≤50	51-100	101-150	151-200	>200	Sum	%
Bahrain	0	0	0	0	1	**1**	**1.9**
Cambodia	0	0	0	0	1	**1**	**1.9**
China	0	0	0	0	11	**11**	**20.4**
Hong Kong	0	0	0	0	1	**1**	**1.9**
Indonesia	0	0	0	0	3	**3**	**5.6**
Macau	0	0	0	0	1	**1**	**1.9**
Malaysia	0	0	0	0	1	**1**	**1.9**
Mexico	0	0	0	0	1	**1**	**1.9**
Pakistan	0	0	0	0	3	**3**	**5.6**
Qatar	0	0	0	0	1	**1**	**1.9**
Russia	0	0	0	0	1	**1**	**1.9**
Saudi Arabia	0	0	0	0	1	**1**	**1.9**
Singapore	0	0	0	0	4	**4**	**7.4**
South Korea	0	0	0	0	2	**2**	**3.7**
Taiwan	0	0	0	0	1	**1**	**1.9**
Thailand	0	0	0	0	2	**2**	**3.7**
UAE	0	0	0	0	12	**12**	**22.2**
USA	0	0	0	0	7	**7**	**13.0**
Sum	**0**	**0**	**0**	**0**	**54**	**54**	**100.0**
%	**0**	**0**	**0**	**0**	**100.0**		

In 2018, there were around 184,300 hotels worldwide. For this reason, Table 6.0-1 and Table 6.0-2 only include a fraction of all hotels. It is only visible that hotels of these dimensions have become an everyday image of modern cities. While hotels already have specific hazards in general, the requirements for fire protection in high-rise buildings are even greater.

Table 6.0-2: Distribution of high-rise buildings used as hotel by number of floors in selected countries.

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum	%
Bahrain	0	0	0	0	1	**1**	**1.9**
Cambodia	0	0	0	0	1	**1**	**1.9**
China	0	0	0	3	8	**11**	**20.4**
Hong Kong	0	0	0	0	1	**1**	**1.9**
Indonesia	0	0	0	2	1	**3**	**5.6**
Macau	0	0	0	0	1	**1**	**1.9**
Malaysia	0	0	0	1	0	**1**	**1.9**
Mexico	0	0	0	1	0	**1**	**1.9**
Pakistan	0	0	1	2	0	**3**	**5.6**
Qatar	0	0	0	0	1	**1**	**1.9**
Russia	0	0	0	1	0	**1**	**1.9**
Saudi Arabia	0	0	0	0	1	**1**	**1.9**
Singapore	0	0	0	0	4	**4**	**7.4**
South Korea	0	0	0	1	1	**2**	**3.7**
Taiwan	0	0	0	0	1	**1**	**1.9**
Thailand	0	0	0	0	2	**2**	**3.7**
UAE	0	0	0	2	10	**12**	**22.2**
USA	0	0	0	0	7	**7**	**13.0**
Sum	**0**	**0**	**1**	**13**	**40**	**54**	**100.0**
%	**0.0**	**0.0**	**1.9**	**24.1**	**74.1**	**100.0**	

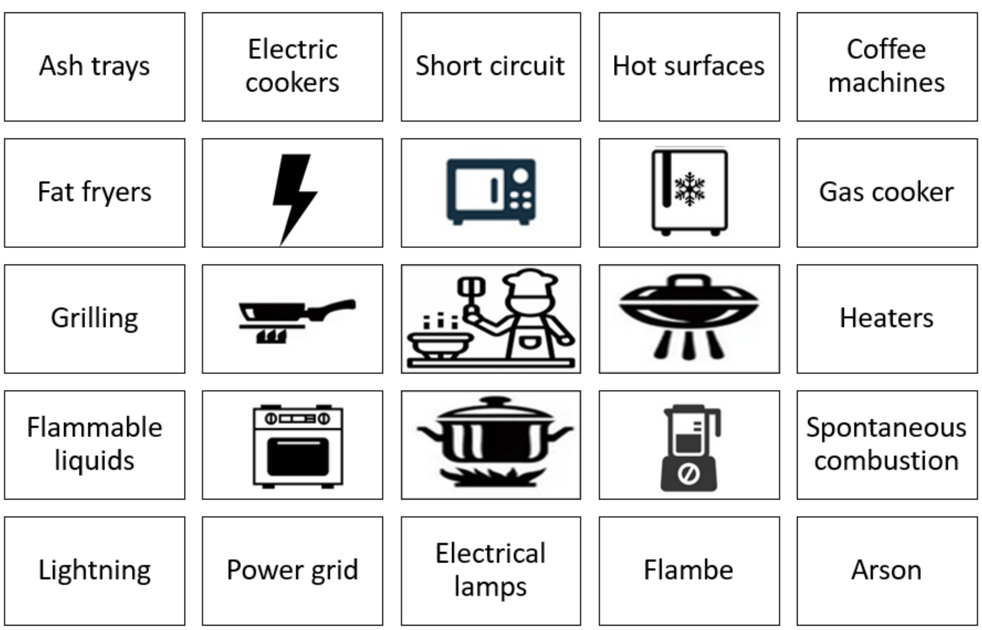


Figure 6.0-1: Fire hazards in hotel restaurants.

In modern hotel buildings, there are many special sections designed to make guests' stay as comfortable as possible. As the building height increases, the number of special sections increases. Facilities such as restaurants, bars, spa areas, etc., are then logically distributed from the ground floor to the attic. In addition, there are modern facilities in the hotel rooms. All sections carry specific hazards.

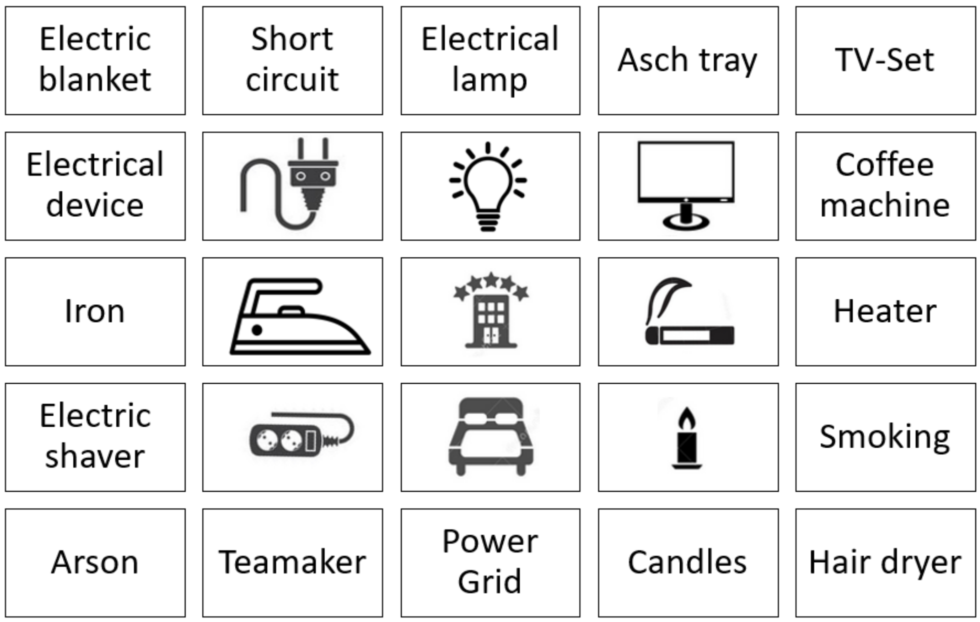


Figure 6.0-2: Fire hazards in hotel guest rooms.

Figure 6.0-3: Fire hazards in hotel storage rooms.

Figure 6.0-1 illustrates the common fire hazards in hotel restaurants. The next section is hotel guest rooms (Figure 6.0-2). Figure 6.0-3 visualizes the fire hazards in hotel storage rooms. Finally, Figure 6.0-4 gives an overview of fire hazards in hotel spa areas.

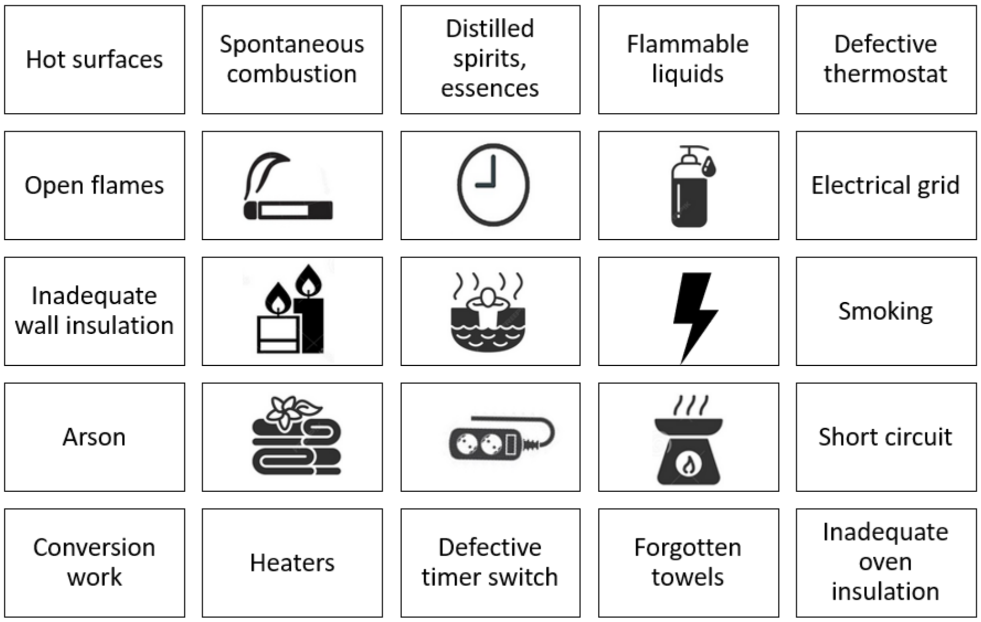


Figure 6.0-4: Fire hazards in hotel spa-areas.

There are many descriptions of what fire safety in hotels means. We will give only three examples here.

Recommendations on fire safety in hotels at **the level of a fire protection association** (NFPA, USA) are as follows:

- Choose a hotel/motel protected by smoke alarms and a fire sprinkler system.
- When you check in, ask the front desk what the fire alarm sounds like.
- When you enter your room, review the escape plan posted there.
- Take the time to find the exits and count the doors between your room and the exit. Make sure the exits are unlocked. If they are locked, report it to management right away.
- Keep your room key by your bed and take it with you if there is a fire.
- If the alarm sounds, leave immediately, closing all doors behind you. Use the stairs—never use elevators during a fire.
- If you must escape through smoke, get low and go under the smoke to your exit. [135]

From the **perspective of the hospitality industry** (UK), there are the following fire safety features. The reasons why fire safety is a top priority in the hotel industry are as follows:

[135] https://www.nfpa.org/downloadable-resources/safety-tip-sheets/hotel-and-motel-safety-tip-sheet.

- Protection of life: The primary goal of fire safety in hotels is to protect the lives of guests and staff. Hotels accommodate a large number of people, and in the event of a fire, swift action and adequate fire safety measures can save lives.
- Prevention of injuries: Fires can cause severe injuries, including burns, smoke inhalation, and physical trauma. By implementing proper fire safety protocols, hotels can minimize the risk of injuries to guests and staff.
- Preservation of property: Fires can cause extensive damage to hotel properties, resulting in significant financial losses. Fire safety measures, such as early detection systems and suppression equipment, help to minimize property damage and reduce the economic impact on the hotel.
- Maintaining business continuity: A fire incident can disrupt hotel operations and lead to temporary closure. By prioritizing fire safety, hotels can ensure uninterrupted operations, protect their reputation, and maintain guest satisfaction.
- Legal and Regulatory Compliance: Hotels are subject to various legal and regulatory requirements for fire safety, and compliance with these standards is essential to avoid penalties, legal consequences, and reputational damage.
- **Enhancing guest confidence:** Guests expect a safe and secure environment when staying at a hotel. By demonstrating a strong commitment to fire safety, hotels can instill confidence in their guests and promote a positive reputation. [136]

From the **point of view of an administration**, in this example from India, exemplary safety recommendations for hotel buildings can look like this:

Construction:

- The construction of the proposed building must be carried out per the approved plan drawings, which comply with the relevant building regulations of the local municipality.
- The more than 750 m2 floor area must be appropriately divided by partitions up to the ceiling with a fire resistance capacity of at least two hours.
- The interior design of the building must be made of materials with low flame propagation that meet specifications.
- Ventilation must be provided at the crown of the central core channel of the building.
- Precautions must be taken to seal all vertical ducts with sufficiently fire-resistant materials.

Open Space:

- The open space surrounding the building must comply with the relevant building regulations and allow the fire engine to be accessible and maneuverable, with the possibility of turning.
- The access roads must be sufficiently strong to withstand the load of a fire engine weighing up to 20 tons.
- The width and height of the site access gates must be at least 4.5 – 5 m in relation to the road.

Staircase:

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[136] https://fireandsecurity.co.uk/category/hospitality/.

- The building's stairs must be closed, and the entire construction must be made of bricks or fire-resistant materials for at least 4 hours.
- The building's staircase must have permanent ventilation slots at the top and open in the outer wall of the building at each floor level.
- The width of the stairs must be designed as marked in the plan. The corridors and exit doors must comply with the relevant building regulations and the provisions of the Cinema Act with current changes.
- The entire staircase must be extended to the terrace of the building and be accessible among each other without entering a room.
- Fire and smoke doors must be provided at the entrances of all stairwell surrounds, as marked on the plan on each floor. The door must be a fire-resistant wired glass window with a self-closing type for at least one hour that can be opened in the escape direction.

Firefighting water:

- There should be an underground water reservoir with a capacity of 10,000 liters and an overhead tank with a capacity of 10,000 liters. The capacity should be exclusively for firefighting, with replenishment equipment capable of 1,000 liters/min. The water supply should come from two different sources.

- The water tank must have an overflow arrangement with the domestic tank to avoid a water level. The water container must be constantly filled.

Hydrant System:

- Provision must be made for a hose reel with a wet riser pipe at each level. Compliance with the relevant specifications must be ensured.

- Standard hose reels, supplied from the overhead tank via the booster pump, must be provided on all floors of the building that meet the applicable standard.

- Courtyard hydrants or main ring hydrants must be installed in sufficient numbers around the building in accordance with the relevant specifications.

Electrical Installation and Distribution:

- The building's electrical installation, including transformers, switchgear, etc., and the building's distribution system must be designed to comply with the Code of Engineering for Fire Protection in General Buildings as set out in the standard specification.

- The vertical ducts must be sealed at a different floor level.

- The electrical system must be adequately protected.

Alternative Power Supply:

- Arrangements shall have to be made to supply power with the help of a generator to operate at least the fire pump, pump for deep tube-well, fire alarm system, fire lift etc.
- Arrangements shall have to be made for illuminating the staircase, corridors etc. and other places of assembly of the building in case of normal power failure.

Detection and alarm system:

- In the control room, it is necessary to set up a manually operated electric fire alarm system with at least three numbers of bulletproof glass-type call boxes equipped with horns, together with a public address system, a talk-back system on each floor, connected to an audiovisual control panel. The control room must be located at the entrance of the ground floor of the building, other requirements for the system must meet the common standards.
- The automatic fire detection system with the help of a flame and smoke detector must be installed in all places below and preferably above the false ceiling of the building. The system must also be placed in places of rooms where valuable items have been stored. The other requirements for the system must be met in accordance with the common standards.
- The audible signal will sound in such a way that an actuation of a detector or a manual call point signal will sound on the same floor and immediately on another floor.

Public Address System:

- A public address system linked between all floors and the control room shall have to be established.

Air conditioning system:

- The system must be separated for each floor, with the system providing air ducts for each floor.
- Provision must be made for insulation in strategic locations by installing automatic dampers in the air conditioning system.
- The automatic shut-off system of the air conditioner must be integrated with the automatic detection and alarm system.
- The space of the ventilation units must not be used to store flammable materials.

First aid firefighting system:

- The first aid arrangements for firefighting in the manner of placing suitable portable fire extinguishers, fire buckets, etc. on all floors and vulnerable areas of the site must be made in accordance with current specifications.

General Recommendations:

- A fire license must be obtained for the proposed storage and processing of L.P.G. and other highly flammable items.

- A fire warning for firefighting and evacuation from the building must be prepared and posted at all vulnerable points of the building.
- The floor numbers and the direction sign of the escape route must be visible.
- Employees and security personnel must be familiar with the fire extinguishing equipment installed in the building and must be active in the event of a fire and during inspections.
- Arrangements shall be made for the periodic inspection, testing, and proper maintenance of all fire protection systems and equipment installed in the building to keep them in perfect working order at all times.
- For the safety of the building, a crew of trained firefighters led by an experienced officer must be maintained around the clock.
- Mock fire and evacuation drills must be carried out regularly with the participation of all building occupants.
- The local Fire and Emergency Services must obtain a certificate of satisfactory services every year, certifying the implementation of all life and fire safety precautions and the installation of the building. [137]

Resumé:

In several large cities, hotels have been set up in high-rise buildings well over 50 m high. Due to external conditions, this trend is expected to continue.

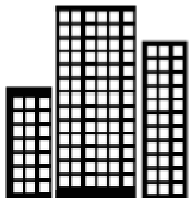
It recommends that local and national administrations compile fire-relevant statistics, which serve as further findings in international comparison.

The administration, the architects, and the local fire service must coordinate safety instructions for hotel guests and employees.

The safety rules must consider the resulting height of the hotel or the number of floors.

[137] West Bengal Fire & Emergency Services, https://wbfes.gov.in/Guidelines?language=en.

7.0 Residential High-rise Building



An international list of 37 buildings is available to consider high-rise buildings used as residential buildings. The buildings are spread over 10 countries. The high-rise buildings were handed over to their use in the period 2005-2024. The buildings have 65 to 101 floors. The height of the building varies between 300 and 472 m. From this information, it can be seen that these are only the tallest buildings of this type. Unsurprisingly, the cities of Dubai and New York City have the most significant shares (Table 7.0-1).

Table 7.0-1: Distribution of residential high-rise buildings by building height in selected cities.

Height, m	**≤50**	**51-100**	**101-150**	**151-200**	**>200**	**Sum**	**%**
Abu Dhabi	0	0	0	0	2	**2**	**5.4**
Astana	0	0	0	0	1	**1**	**2.7**
Bangkok	0	0	0	0	1	**1**	**2.7**
Busan	0	0	0	0	3	**3**	**8.1**
Dubai	0	0	0	0	13	**13**	**35.1**
Gold Coast	0	0	0	0	1	**1**	**2.7**
Melbourne	0	0	0	0	1	**1**	**2.7**
Moscow	0	0	0	0	3	**3**	**8.1**
Mumbai	0	0	0	0	2	**2**	**5.4**
New York City	0	0	0	0	7	**7**	**18.9**
Ningbo	0	0	0	0	1	**1**	**2.7**
Riyadh	0	0	0	0	1	**1**	**2.7**
Shenzhen	0	0	0	0	1	**1**	**2.7**
Sum	**0**	**0**	**0**	**0**	**37**	**37**	**100.0**
%	**0.0**	**0.0**	**0.0**	**0.0**	**100.0**	**100.0**	

Table 7.0-2 shows that the sample considered here contains only buildings with several floors of more than 50. That makes generalization pointless. The real number of residential high-rises per city is many times higher. Here are just a few examples. That happens regardless of the national definitions, from what height or number of floors we speak of a high-rise. As a guideline, 22m or the 8th floor can be assumed. Why? These values correspond more or less precisely to the operational limits of a "normal" fire brigade turntable ladder. We list a lot more about this below. For example, it is assumed that there are around 2,400 high-rise buildings in Berlin (the capital of Germany with around 2.4 million inhabitants). Most of the buildings are located well below the 100 m height. About 600 high-rise buildings in the Vietnamese capital, Hanoi, of which 48% have 9 to 19 floors, and 35% have 20 to 29 floors. In Shanghai (China), there were around 8,200 buildings with 8 to 10 floors in 2022, according to local statistics. That is followed by about 23,000 buildings with 11 to 15 floors. Then let's look at Tokyo (Japan, 2022): 12,700 buildings with eight floors, around 9,800 buildings with nine floors, and 8,200 buildings with 10 floors.

Table 7.0-2: Distribution of residential high-rise buildings by number of floors in selected cities.

Number of Floors	≤10	11-20	21-30	31-50	>50	Sum	%
Abu Dhabi	0	0	0	0	2	**2**	**5.4**
Astana	0	0	0	0	1	**1**	**2.7**
Bangkok	0	0	0	0	1	**1**	**2.7**
Busan	0	0	0	0	3	**3**	**8.1**
Dubai	0	0	0	0	13	**13**	**35.1**
Gold Coast	0	0	0	0	1	**1**	**2.7**
Melbourne	0	0	0	0	1	**1**	**2.7**
Moscow	0	0	0	0	3	**3**	**8.1**
Mumbai	0	0	0	0	2	**2**	**5.4**
New York City	0	0	0	0	7	**7**	**18.9**
Ningbo	0	0	0	0	1	**1**	**2.7**
Riyadh	0	0	0	0	1	**1**	**2.7**
Shenzhen	0	0	0	0	1	**1**	**2.7**
Sum	**0**	**0**	**0**	**0**	**37**	**37**	**100.0**
%	**0.0**	**0.0**	**0.0**	**0.0**	**100.0**	**100.0**	

What are the leading causes of fires in high-rise residential buildings? We have examined the national arguments on this question very accurately and cautiously and have finally arrived at a general form, as presented in Figure 7.0-1.

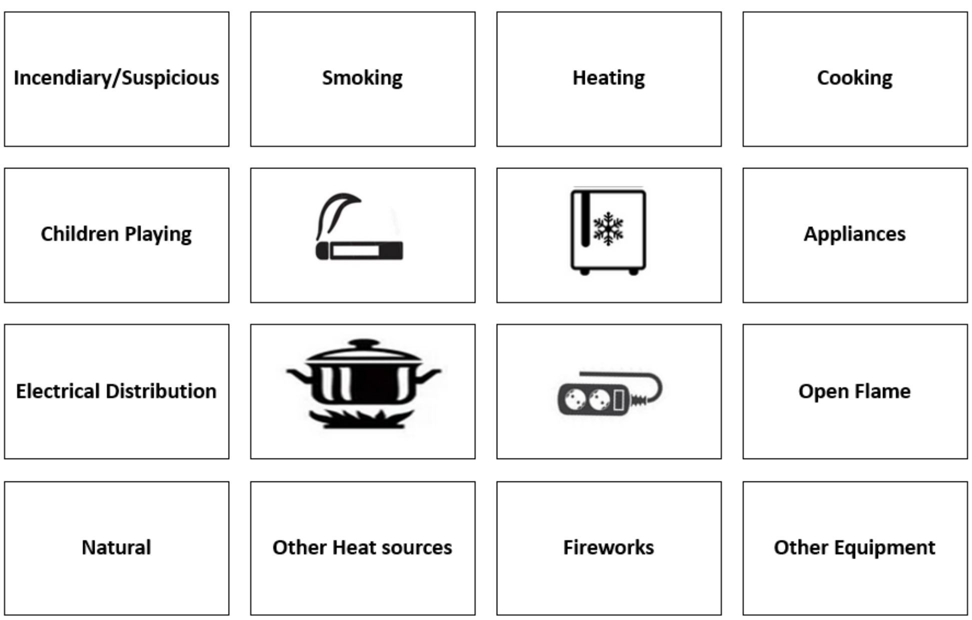


Figure 7.0-1: Main causes of fires in residential high-rise buildings.

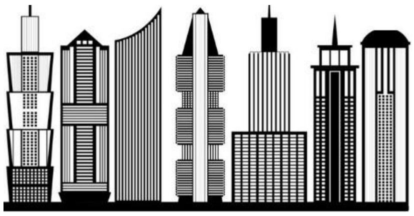
A fire in a residential high-rise building always leads to numerous damages. The causes of the fires do not differ significantly from the causes of ignition in buildings with a lower number of floors:

- Careless handling of fire (unextinguished candles, other objects with open fires);
- Smoking (cigarettes and other tobacco products, as well as matches and lighters);
- Improper storage of flammable substances (e.g., paints and varnishes);
- Placement of combustible materials (paper products, textiles, etc.) near lighting fixtures or stoves;
- Faulty gas appliances (gas leakage due to leakage of connecting units);
- Faulty electrical appliances (short circuit in wiring, etc.);
- Arson, intentional property damage.

Resumé:

- Residential high-rises have ever higher building heights and thus an increasing number of floors.
- There is a tendency to see mixed types of use increasingly finding their way into high-rise residential buildings. Shops, service facilities, restaurants, and many other facilities are located not only on the lowest floors of the buildings but on different floors, including the top floors.
- For technical reasons, no continuous elevators are above a specific building height. To get to the top floors, people have to change elevators. Other technical systems (heating, cooling, ventilation, water transport, waste disposal, etc.) are also subject to certain limitations.
- Demographic effects, i.e., the aging of people, do not stop at residential high-rises. People with disabilities of various kinds and old age live in residential high-rises. As long as the technical systems work, all residents can move (or be moved) safely in the building.
- New challenges to the safety of residential high-rise buildings can be identified: the use of combustible exterior façades and the construction of wood buildings.
- The fire brigades should accept these questions and record fire incidents in statistics. Only a larger number of recorded cases at the international level can help to acquire new knowledge.

8.0 Fires in High-rise Buildings



In this section, we look at the overview of 144 high-rise fires from 1911 to 2024, compiled from various sources. The tables below are designed according to the same time intervals, as we have already done in section 3, "Selected case studies about international High-rise fires" (Table 8.0-1).

Table 8.0-1: Comparison of the number of fires in sections 3.0 and 8.0.

Years	Section 3 "Selected case studies about international High-rise fires"		Section 8 "Fires in High-rise Buildings"	
	Sum of studied fires	%	Sum of studied fires	%
1911-1984	7	6.2	24	16.7
1985-1989	8	7.1	6	4.2
1990-1994	4	3.5	8	5.6
1995-1999	11	9.7	5	3.5
2000-2004	14	12.4	13	9.0
2005-2009	13	11.5	17	11.8
2010-2014	28	24.8	22	15.3
2015-2019	19	16.8	26	18.1
2020-2024	9	8.0	23	16.0
Total	**113**	**100**	**144**	**100**

Table 8.0-2 presents the distribution of high-rise fires according to time intervals and type of building use. It should be noted that the first interval is significantly different from all the others. The intervals between 2005 and 2024 account for the most significant shares. The top 5 by type of use are high-rise office buildings (33%), residential high-rises (31%), buildings under construction (11%), hotels (9%), and buildings with an undetectable type of use (almost 8%).

As far as can be determined, the number of victims could be assigned to the individual high-rise fires. Table 8.0-3 illustrates the distribution of the number of fire deaths by time intervals and type of building use. A total of 4168 deaths were registered. The largest expressions by time interval can be found for 2000-2004 (56%, mainly due to the 9/11 events), 1990-1994 (almost 6%), and 2020-204 (5%). According to the type of use of high-rise buildings, we see that office high-rises (70%, mainly due to the 9/11 events), hotels (13%), and residential high-rises (10%) dominate.

The distribution of the number of burn injuries in the examination fire cases according to time intervals and type of use is the focus of Table 8.0-4. The total number of n=5027 is distributed as follows. The highest proportions were recorded in 1990-1994 (21%), 2015-2019 (8%) and 2020-2024 (9%). About the type of use of high-rise buildings, 50% of the injuries were caused by fires in office buildings. Hotels and residential buildings follow with 27% (15%).

Table 8.0-2: Distribution of high-rise fires by time intervals and type of use (n=144).

Type of use	**1911-1984**	**1985-1989**	**1990-1994**	**1995-1999**	**2000-2004**	**2005-2009**	**2010-2014**	**2015-2019**	**2020-2024**	**Sum**	**%**
Factory	1	0	-	-	-	-	-	-	-	**1**	**0.7**
Hotel	5	2	-	1		1	1	3	-	**13**	**9.0**
Hotel, residential			-	-	-	-	-	1	-	**1**	**0.7**
Offices	12	3	3	2	8	5	4	7	4	**48**	**33.3**
Offices, residential	-	-	-	-	-	-	-	1	-	**1**	**0.7**
Offices, shopping	1	0	-	-	-	-	-	-	-	**1**	**0.7**
Residential	2	1	2	1	2	5	10	10	12	**45**	**31.3**
Residential, hotel	1	0	-	-	-	-	1	-	-	**2**	**1.4**
Residential, offices	-	-	-	-	-	-	-	1	-	**-**	**0.7**
Shopping, offices	-	-	-	-	-	1	-	-	2	**3**	**2.1**
TV-tower	-	-	-	-	1		-	-	-	**1**	**0.7**
Under construction	1	0	1	-	-	5	5	1	3	**16**	**11.1**
Unknown	1	0	2	1	2	-	-	2	2	**11**	**7.6**
Total	**24**	**6**	**8**	**5**	**13**	**17**	**22**	**26**	**23**	**144**	**100**
%	**16,7**	**4,2**	**5,6**	**3,5**	**9,0**	**11,8**	**15,3**	**18,1**	**16,0**		

Table 8.0-3: Distribution of the number of fire deaths by time intervals and type of use (n=4168).

Type of use	**1911-1984**	**1985-1989**	**1990-1994**	**1995-1999**	**2000-2004**	**2005-2009**	**2010-2014**	**2015-2019**	**2020-2024**	**Sum**	**%**
Factory	146	-	-	-	-	-	-	-	-	**146**	**3.5**
Hotel	436	103	-	8		0	0	0	-	**547**	**13.1**
Hotel, residential	-	-	-	-	-	-	-	1	-	**1**	**0.0**
Offices	228	6	196	41	2,322	2	38	56	46	**2,935**	**70.4**
Offices, residential	-	-	-	-	-	-	-	1	-	**1**	**0.0**
Offices, shopping	1	-	-	-	-	-	-	-	-	**1**	**0.0**
Residential	4	7	47	-	2	118	64	84	112	**438**	**10.5**
Residential, hotel	0	-	-	-	-	-	0	-	-	**0**	**0.0**
Residential, offices	-	-	-	-	-	-	-	-	-	**0**	**0.0**
Shopping, offices	-	-	-	-	-	4		0	46	**50**	**1.2**
TV-tower	-	-	-	-	5	-	-	-	-	**5**	**0.1**
Under construction	0		0	-	-	4	0	0	0	**4**	**0.1**
Unknown	11			0	4	-	0	15	10	**40**	**1.0**
Total	**826**	**116**	**243**	**49**	**2,333**	**128**	**102**	**157**	**214**	**4,168**	**100**
%	**19,8**	**2,8**	**5,8**	**1,2**	**56,0**	**3,1**	**2,4**	**3,8**	**5,1**		

Table 8.0-4: Distribution of the number of fire injuries by time intervals and type of use (n=5027).

Type of use	1911-1984	1985-1989	1990-1994	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019	2020-2024	Sum	%
Factory	-	-	-	-	-	-	-	-	-	**0**	**0,0**
Hotel	1178	146	-	34	-	13	0	2	-	**1373**	**27,3**
Hotel, residential	-	-	-	-	-	-	-	14	-	**14**	**0,3**
Offices	826	78	1042	81	33	132	126	153	54	**2525**	**50,2**
Offices, residential	-	-	-	-	-	-	-	6	-	**6**	**0,1**
Offices, shopping	-	-	-	-	-	-	-	-	-	**0**	**0,0**
Residential	31	-	26		5	138	75	157	324	**756**	**15,0**
Residential, hotel	-	-	-	-	-	-	-	-	-	**0**	**0,0**
Residential, offices	-	-	-	-	-	-	-	5	-	**5**	**0,1**
Shopping, offices	-	-	-	-	-	50			75	**125**	**2,5**
TV-tower	-	-	-	-	-	-	-	-	-	**0**	**0,0**
Under construction	-	-	-	-	-	-	12	-	0	**12**	**0,2**
Unknown	-	-	-	-	77	60	2	63	9	**211**	**4,2**
Total	**2035**	**224**	**1068**	**115**	**115**	**393**	**215**	**400**	**462**	**5027**	**100**
%	**40,5**	**4,5**	**21,2**	**2,3**	**2,3**	**7,8**	**4,3**	**8,0**	**9,2**		

Table 8.0-5: Absolute and relative parameters for the sample of 144 high-rise fires from 1911 to 2024 (113 years).

Type of use	n	D	I	D/F	I/F	D/a	I/a
Factory	1	146	0	146.0	0.0	1.292	0.000
Hotel	13	547	1,373	42.1	105.6	4.841	12.150
Hotel, residential	1	1	14	1.0	14.0	0.009	0.124
Offices	48	2,935	2,525	61.1	52.6	25.973	22.345
Offices, residential	1	1	6	1.0	6.0	0.009	0.053
Offices, shopping	1	1	0	1.0	0.0	0.009	0.000
Residential	45	438	756	9.7	16.8	3.876	6.690
Residential, hotel	2	0	0	0.0	0.0	0.000	0.000
Residential, offices	1	0	5	0.0	5.0	0.000	0.044
Shopping, offices	3	50	125	16.7	41.7	0.442	1.106
TV-tower	1	5	0	5.0	0.0	0.044	0.000
Under construction	16	4	12	0.3	0.8	0.035	0.106
Unknown	11	40	211	3.6	19.2	0.354	1.867
Total	**144**	**4,168**	**5,027**	**28.9**	**34.9**	**36.885**	**44.487**

In Tables 8.0-1 to 8.0-4, we present the general representations of the high-rise fires considered in this section. Some restrictions had to be accepted. On the one hand, the attempt to orient ourselves on the time intervals from the literature source [32] means that the period from 1911 to 1984 is considerable compared to the other time intervals considered here. Furthermore, the number of cases according to the type of use of the high-rise buildings was presented so that variants emerged. For example, there are combinations of "Offices," "Offices, residential," and "Offices, shopping." The term "offices" alone signals a primary type of use of the high-rise. In this case, the type of use "Offices, residential" only says that both types of use are present, but no statement can be made about which type of use is dominant.

Table 8.0-6: Fires in high-rise buildings in the years 1911-1984.

No.	Building	City	Country	Date	D	I
1	Asch Building	New York City	USA	March 25, 1911	146	n.a.
2	The Sherry-Netherland	New York City	USA	April 12, 1927	0	n.a.
3	Empire State Building	New York City	USA	July 28, 1945	14	24
4	40 Wall Street	New York City	USA	May 20, 1946	5	n.a.
5	La Salle Hotel	Chicago	USA	June 5, 1946	61	n.a.
6	Winecoff Hotel	Atlanta	USA	December 7, 1946	119	65
7	Ronan Point	London	UK	May 16, 1968	4	17
8	1 New York Plaza	New York City	USA	August 5, 1970	2	35
9	Taeyongak Hotel	Seoul	South Korea	December 25, 1971	164	63
10	Andraus Building	São Paulo	Brazil	February 24, 1972	16	330
11	Rault Tower	New Orleans	USA	November 29, 1972	6	n.a.
12	Avianca Building	Bogotá	Colombia	July 23, 1973	4	63
13	City-Haus	Frankfurt	Germany	August 23, 1973	0	n.a.
14	Joelma Building	São Paulo	Brazil	February 1, 1974	179	300
15	One World Trade Center	New York City	USA	February 13, 1975	1	64
16	Campbell Shopping Complex	Kuala Lumpur	Malaysia	April 8, 1976	1	n.a.
17	Bank Bumiputra	Kuala Lumpur	Malaysia	November 4, 1980	n.a.	n.a.
18	MGM Grand Hotel	Las Vegas	USA	November 21, 1980	84	700
19	Las Vegas Hilton	Las Vegas	USA	February 10, 1981	8	350
20	Torre Santa María	Santiago	Chile	March 21, 1981	11	n.a.
21	Residential Block	Dresden	Germany	August 12, 1981	n.a.	14
22	Al Rasheed Hotel	Baghdad	Iraq	July 21, 1982	1	n.a.
23	Northwestern National Bank	Minneapolis	USA	November 25, 1982	0	10
24	KOMTAR	Penang	Malaysia	January 23, 1983	0	n.a.

When these constraints are considered, Table 8.0-5 summarizes the absolute and relative parameters of all high-rise fires considered here. Table column [n] lists the number of cases per type of use for 144 high-rise fires [F]. The top 3 office high-rises, residential high-rises, and high-rise buildings under construction are to be named. Four thousand one hundred sixty-eight deaths [D] were reported in these high-rise fires. The top 3 are office buildings, hotels, and residential high-rises. The number of victims is serious due to the 9/11 events. If one looks at the number of people injured [I] in high-rise fires, then among the total of 5027 people, there are particular victims in office buildings, hotels, and high-rise residential buildings.

Let us look at the average number of victims per year [a], broken down by type of use of the buildings. The average number of deaths [D] in high-rise fires varies between 0 and 146 [D/a]. If we exclude the individual case of a factory fire (146 deaths), then the focus is on high-rise office buildings (61 D/F) and high-rise hotel buildings (42 D/F). The number of injuries per fire [I/F] is highest in high-rise hotel buildings (106 I/F). The other places are occupied by high-rise office buildings (53 I/F) and high-rise buildings with "shopping offices" (42 I/F).

Table 8.0-7: Fires in high-rise buildings in the years 1985-1989.

No.	Building	City	Country	Date	D	I
1	Prudential Tower	Boston	USA	January 2, 1986	0	n.a.
2	Dupont Plaza Hotel	Condado	Puerto Rico	December 31, 1986	97	146
3	Schomburg Plaza	New York City	USA	March 22, 1987	7	n.a.
4	Hotel International	Zurich	Switzerland	February 14, 1988	6	n.a.
5	First Interstate Tower	Los Angeles	USA	May 4, 1988	1	40
6	Peachtree 25th Building	Atlanta	USA	June 30, 1989	5	38

Table 8.0-8: Fires in high-rise buildings in the years 1990-1994.

No.	Building	City	Country	Date	D	I
1	One Meridian Plaza	Philadelphia	USA	February 23, 1991	3	n.a.
2	Knowsley Heights Apartment Block	Liverpool	UK	1991	n.a.	n.a.
3	UNITIC Twin Towers	Sarajevo	Bosnia and Herzegovina	May 28, 1992	n.a.	n.a.
4	Executive Council Building	Sarajevo	Bosnia and Herzegovina	May 28, 1992	n.a.	n.a.
5	Groeneveen and Kruitberg	Amsterdam	Netherlands	October 4, 1992	47	26
6	One World Trade Center	New York City	USA	February 26, 1993	6	1042
7	Stratosphere Tower	Las Vegas	USA	August 30, 1993	0	n.a.
8	White House (Moscow)	Moscow	Russia	October 8, 1993	187	n.a.

Table 8.0-9: Fires in high-rise buildings in the years 1995-1999.

No.	Building	City	Country	Date	D	I
1	Hotel Olympik	Prague	Czech Republic	May 25, 1995	8	34
2	Tower 42	London	UK	January 17, 1996	0	0
3	Garley building	Hong Kong	Hong Kong	November 20, 1996	41	81
4	Ušće Tower	Belgrade	Serbia and Montenegro	April 21, 1999	0	n.a.
5	Garnock Court	Irvine (Scotland)	UK	1999	n.a.	n.a.

Finally, we turn our attention to the sum line of Table 8.0-5. Over the entire observation period (1911-2024), n=144 high-rise fires were recorded, in which D=4168 dead and I=5027 injured were registered. On average, there were 29 deaths per fire [D/F] and 35 injuries per fire [I/F]. About 113 years [a], 37 deaths [D/a], and 45 injuries [I/a] had to be mourned. The average values determined are subject to significant fluctuations. However, despite all the imponderable work of the tiny sample, it became visible that high-rise fires are concentrated in hotels, offices, and residential buildings.

Finally, we present all the high-rise fires considered here in chronological order to the intervals defined at the beginning (Table 8.0-6 to Table 8.0-14). Wherever it could be determined, the local names of the high-rise buildings were entered. The name of the city, the state, and the date follow that. Then, each fire incident is supplemented with the determined number of victims (D – dead, I – injured; n.a. – not applicable).

Table 8.0-10: Fires in high-rise buildings in the years 2000-2004.

No.	Building	City	Country	Date	D	I
1	Immigration Tower	Hong Kong	Hong Kong	August 2, 2000	2	1
2	Ostankino TV Tower	Moscow	Russia	August 27, 2000	5	n.a.
3	1 and 2 World Trade Center	New York City	USA	September 11, 2001	2,312	n.a.
4	7 World Trade Center	New York City	USA	September 11, 2001	0	n.a.
5	90 West Street	New York City	USA	September 11, 2001	2	n.a.
6	130 Cedar Street	New York City	USA	September 11, 2001	0	n.a.
7	Pirelli Tower	Milan	Italy	April 18, 2002	3	60
8	Condominium	Clearwater	USA	June 28, 2002	2	0+5
9	Cook County Administration Building	Chicago	USA	October 17, 2003	6	7
10	Al Rasheed Hotel	Baghdad	Iraq	December 26, 2003	1	17
11	Petershill Court	Glasgow	UK	2003	n.a.	n.a.
12	Parque Central Complex East tower	Caracas	Venezuela	October 17, 2004	0	n.a.
13	LaSalle National Bank Building	Chicago	USA	December 7, 2004	0	25

Table 8.0-11: Fires in high-rise buildings in the years 2005-2009.

No.	Building	City	Country	Date	D	I
1	Harrow Court	Stevenage	UK	February 2, 2005	3	7
2	Windsor Tower	Madrid	Spain	February 12, 2005	0	7
3	Tohid Town Residential	Tehran	Iran	December 6, 2005	106	90
4	Transport Tower	Astana	Kazakhstan	May 30, 2006	0	3
5	Belaire Apartments	New York City	USA	October 11, 2006	2	21
6	Fortune Tower	Dubai	UAE	January 18, 2007	4	60
7	Shanghai World Financial Center	Shanghai	China	August 14, 2007	0	0
8	Deutsche Bank Building	New York City	USA	August 18, 2007	2	115
9	The Water Club	Atlantic City	USA	September 23, 2007	0	n.a.
10	Monte Carlo Resort and Casino	Las Vegas	USA	January 25, 2008	0	13
11	TU Delft Faculteitsgebouw	Delft	Netherlands	April 13, 2008	0	n.a.
12	Abraj Al Bait Towers (Hajar Tower)	Mecca	Saudi Arabia	October 28, 2008	0	n.a.
13	Beijing Television Cultural Center	Beijing	China	February 9, 2009	1	7
14	Bashundhara City Tower	Dhaka	Bangladesh	March 13, 2009	4	50

No.	Building	City	Country	Date	D	I
15	Abraj Al Bait Towers (Safa Tower)	Mecca	Saudi Arabia	May 1, 2009	0	0
16	Lakanal House	London	UK	July 3, 2009	6	20
17	Waddell Court	Glasgow	UK	2009	1	n.a.

Table 8.0-12: Fires in high-rise buildings in the years 2010-2014.

No.	Building	City	Country	Date	D	I
1	Rabobank Bestuurscentrum	Utrecht	Netherlands	June 27, 2010	0	n.a.
2	Wooshin Golden Suites	Busan	South Korea	September 1, 2010	0	5
3	Unnamed high-rise apartment block	Shanghai	China	November 15, 2010	58	70
4	Madingley, Cambridge Estate	Kingston upon Thames	UK	2010	n.a.	n.a.
5	Dynasty Wanxin building complex	Shenyang	China	February 3, 2011	0	0
6	EVN Headquarters Tower 1	Hanoi	Vietnam	December 15, 2011	0	11
7	Uncompleted high-rise block	Kuala Lumpur	Malaysia	January 18, 2012	0	0
8	Fico Place	Bangkok	Thailand	March 3, 2012	0	2
9	Federation Tower (East Tower)	Moscow	Russia	April 2, 2012	0	0
10	Al Tayer Tower	Dubai	UAE	April 28, 2012	0	n.a.
11	Polat Tower Residence	Istanbul	Türkiye	July 17, 2012	0	n.a.
12	Tamweel Tower	Dubai	UAE	November 18, 2012	0	n.a.
13	Oko Tower 1	Moscow	Russia	January 25, 2013	0	1
14	Torre Ejecutiva Pemex Tower	Mexico City	Mexico	January 31, 2013	37	121
15	Grozny-City Towers Olympus	Grozny	Russia	April 3, 2013	0	n.a.
16	Jianye Mansion	Guangzhou	China	December 15, 2013	0	n.a.
17	Parque Central Complex West tower	Caracas	Venezuela	November 12, 2013	0	0
18	The Strand	New York City	USA	January 5, 2014	1	n.a.
19	One57	New York City	USA	March 15, 2014	0	n.a.
20	Lotus Park building	Mumbai	India	July 18, 2014	1	5
21	Lacrosse Apartments	Melbourne	Australia	November 25, 2014	0	n.a.
22	The Wedgwood	Castle Hills	USA	December 28, 2014	5	n.a.

Table 8.0-13: Fires in high-rise buildings in the years 2015-2019.

No.	Building	City	Country	Date	D	I
1	The Marina Torch	Dubai	UAE	February 21, 2015	0	7
2	Wisma Kosgoro	Jakarta	Indonesia	March 10, 2015	0	n.a.
3	Unnamed High-rise	Baku	Azerbaijan	May 19, 2015	15	63
4	Cosmopolitan of Las Vegas	Las Vegas	USA	July 25, 2015	0	2
5	Unnamed Residential Tower	Sharjah	UAE	October 1, 2015	0	19
6	John Hancock Center	Chicago	USA	November 21, 2015	0	5
7	The Address Downtown Dubai	Dubai	UAE	December 31, 2015	1	14
8	Sulafa Tower	Dubai	UAE	July 20, 2016	0	n.a.

No.	Building	City	Country	Date	D	I
9	Trump International Hotel/Tower	Baku	Azerbaijan	August 11, 2016	n.a.	n.a.
10	Plasco Building	Tehran	Iran	January 19, 2017	20	70
11	Grenfell Tower	London	UK	June 14, 2017	72	74
12	Pamchal Chitgar Building	Tehran	Iran	June 14, 2017	0	4
13	Marco Polo Apartments	Honolulu	USA	July 14, 2017	4	13
14	Rotana Hotel Building	Mashhad	Iran	July 22, 2017	0	n.a.
15	The Marina Torch	Dubai	UAE	August 4, 2017	0	0
16	Trump Tower	New York City	USA	April 7, 2018	1	6
17	Almas Tower	Dubai	UAE	April 22, 2018	0	0
18	Trump International Hotel/Tower	Baku	Azerbaijan	April 28, 2018	0	n.a.
19	Wilton Paes de Almeida Building	São Paulo	Brazil	April 30, 2018	7	n.a.
20	Paramis Building	Tehran	Iran	July 22, 2018	0	n.a.
21	Bank of Lisbon building	Johannesburg	South Africa	September 6, 2018	3	13
22	John Hancock Center	Chicago	USA	February 11, 2018	0	0
23	FR Tower	Dhaka	Bangladesh	March 28, 2019	25	70
24	AXA Equitable Center	New York City	USA	June 10, 2019	1	0
25	Unnamed High-rise	Prešov	Slovakia	December 6, 2019	8	40
26	The Marina Torch	Dubai	UAE	5 January 2019	0	0

Table 8.0-14: Fires in high-rise buildings in the years 2020-2024.

No.	Building	City	Country	Date	D	I
1	Abbco Tower	Sharjah	UAE	May 5, 2020	1	25
2	Tower block at 1158 Nerudova street	Bohumin	Czech Republic	August 9, 2020	11	15
3	Ulsan Samhwan Art Nouveau apartment building	Ulsan	South Korea	October 8, 2020	0	93
4	Torre dei Moro	Milan	Italy	August 29, 2021	0	n.a.
5	Cheng Chung Cheng Building	Kaohsiung	Taiwan	October 14, 2021	46	41
6	World Trade Centre Hong Kong	Hong Kong	Hong Kong	December 15, 2021	0	13
7	Twin Parks North West, Site 4	New York City	USA	January 9, 2022	17	44
8	Lotus Garden China Telecom	Changsha, Hunan	China	September 16, 2022	0	0
9	The Centaurus	Islamabad	Pakistan	October 9, 2022	0	n.a.
10	RiverCourt	New York City	USA	November 5, 2022	0	38
11	8 Boulevard Walk	Dubai	UAE	November 7, 2022	0	n.a.
12	Jixiangyuan community	Ürümqi	China	November 26, 2022	10	9
13	The Kimpton	Hong Kong	Hong Kong	March 2, 2023	0	0
14	Unnamed Apartment Block	Hanoi	Vietnam	September 12, 2023	56	37
15	Greater Nile Petroleum Oil Company Tower	Khartoum	Sudan	September 17, 2023	n.a.	n.a.
16	Residential Block	Berlin	Germany	July 29, 2023	2	n.a.
17	Unnamed High-rise	València	Spain	February 22, 2024	10	15

No.	Building	City	Country	Date	D	I
18	Unnamed High-rise	Nanjing	China	February 23, 2024	15	44
19	Green Cozy Cottage Shopping Mall	Dhaka	Bangladesh	February 29, 2024	46	75
20	Yuzhny-D Micro district	Tver	Russia	March 14, 2024	0	n.a.
21	Botanik Torre Flora	Recife	Brazil	March 28, 2024	0	0
22	Residential Block	Berlin	Germany	October 6, 2024	0	2
23	Residential Block	Berlin	Germany	May 11, 2024	0	11

Unfortunately, it was impossible to determine a clear statement about the causes of the fire for each of the cases considered in this section. However, if mentioned, the result is a picture, as shown in Figure 8.0-1. It is worth noting that in some cases, the collision of aircraft is indicated as the cause (see Section 3).

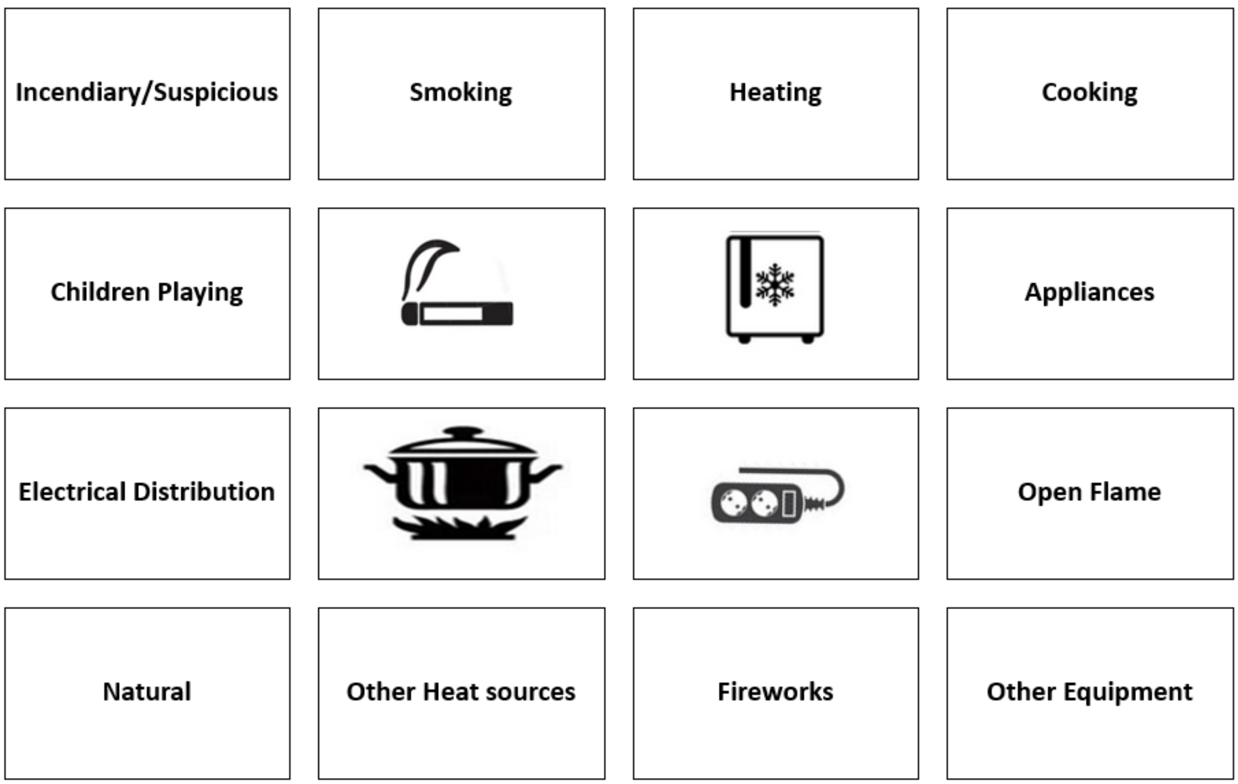


Figure 8.0-1: Most common causes in high-rise buildings.

To obtain confirmation of the leading causes identified in Figure 8.0-1, we attach a national statistic (Table 8.0-15). The leading causes of high-rise buildings are highlighted.

Table 8.0-15: Leading causes of high-rise fires in the USA (n=10,600 fires as annual average for 2009-2013). [138]

High-rise fires (7-100 stories)	Type of property by use, in %				
	Apartments or other multi-family (n=8,970)	Hotels or motels (n=540)	Dormitories (n=510)	Office buildings (n=290)	Facilities that care for the sick (n=260)
Cooking equipment	75	45	73	36	51
Smoking materials	7	10	6	5	
Intentional	3	4	8	7	9
Heating equipment	3	4		7	
Electrical distributor or lighting	2	6		15	7
Clothes dryer or washer	-	7			
Air conditioner or fan	-	3		4	
Candles	-		4		
Electronic, office or entertainment equipment	-				3
Other causes	10	21	9	26	30
Sum, %	**100**	**100**	**100**	**100**	**100**

Resumé: Fires in high-rise buildings occur worldwide and in all types of use of buildings.

In the event of a fire in a high-rise building, the dangers for people are higher because, unlike flat buildings, evacuation is challenging. The complexity of firefighting is also greater.

It recommends that local and national administrations compile fire-relevant statistics, which serve as further findings in international comparison.

Resumé: The main reasons for fires in high-rise buildings are:

- The escape routes contain combustion products (toxic gases) and fire (high temperatures).
- Combustion products fill evacuation exits, elevator shafts, and stairwells. Visibility for people is drastically reduced.
- The rapid vertical development of the fire characterizes high-rise buildings.
- Difficulties lie in the complexity of evacuation and rescue operations.
- Elevator systems and fire protection systems often fail in the event of a fire.

[138] Marty Ahrens: High-Rise Building Fires, (11/2016), NFPA Fire Analysis & Research, Quincy, MA.

Resumé: Smoke and fire spread in high-rise buildings:

- The speed of vertical spread of smoke and toxic gases within a high-rise building can reach several tens of meters per minute.
- In a few minutes, the building will be completely filled with smoke. Under these conditions, it is impossible for people to be on the premises without respiratory protection.
- The heaviest smoke development occurs on the upper floors, where fire investigation, rescue of people, and the supply of extinguishing agents are complicated.

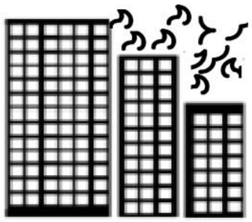
Resumé: Firefighting in high-rise buildings is complicated by a number of factors:

- The presence of a large number of people in need. The occurrence of panic is not rare.
- The spread of fire and toxic combustion products vertically both inside and outside the building.
- Smoke in stairwells and upper floors through elevator shafts and other vertical ducts.
- High temperatures on the evacuation routes on the floors where the fire broke out (in corridors, stairwells).
- Complexity and labor intensity in the provision of extinguishing agents, especially on the upper floors of the building.
- The lack of access platforms, which makes it difficult to install ladders and lifting platforms for rescue operations.
- Difficulties in managing a large number of crews and equipment related to fire extinguishing;
- and much more.

Resumé: Factors that contributed to the tragic development of the fire events were the following:

- Low fire resistance of structures and technical equipment, in particular, metal beams and trusses.
- The presence of large indoor spaces that are not separated by fire barriers.
- Many flammable appliances, furniture, cladding.
- A small number of stairwells and a narrow width of evacuation stairs.
- The presence of numerous penetrations in the walls and ceilings for air conditioning, electrical equipment, and other technological requirements.
- Lack of evacuation plans in the event of fire.
- Installation of suspended ceilings.

9.0 Façades Fires in High-rise Buildings



The façades of high-rise buildings are clad with diverse materials for various reasons. Depending on where the buildings are built, the insulating façades should protect against cold, heat, weather-related influences, wind, etc., or several factors simultaneously. Last but not least, the influence of architectural beauty also plays a role. Suppose one looks at the cases of façade fires of buildings in general and those of high-rise buildings in particular. In that case, some questions arise about the background, especially since the events are critically questioned in the media. In the case of the burned-out Grenfell Tower, the façade insulation acted as an accelerant. The worrying thing is that the UK has now tested the façades of 600 other high-rise buildings in England. All of them failed the examinations. In many countries, such studies will likely bring similar results to light.

Table 9.0-1: Comparison of the number of fires in sections 3.0 and 9.0.

Years	Section 8 "Fires in High-rise Buildings"		Section 9 "Façades Fires in High-rise Buildings"	
	Sum of studied fires	%	Sum of studied fires	%
1911-1984	24	16.7	-	-
1985-1989	6	4.2	-	-
1990-1994	8	5.6	4	6.1
1995-1999	5	3.5	5	7.6
2000-2004	13	9.0	3	4.5
2005-2009	17	11.8	8	12.1
2010-2014	22	15.3	15	22.7
2015-2019	26	18.1	23	34.8
2020-2024	23	16.0	8	12.1
Total	**144**	**100**	**66**	**100**

Table 9.0-1 compares the number of cases in the respective section. Tables 9.02 to 9.0-8 reflect the number of cases according to the intervals presented in Table 9.0-1. In addition to the date, building name, city, and state, the number of victims (dead [D], injured [I]) and the floors affected by the fire are given as far as can be determined.

Table 9.0-2: High-rise façade fires in 1990-1994.

N	Date	Building	City	Country	D	I	AF
1	January 10, 1990	393 Kennedy St	Winnipeg	Canada	n.a.	n.a.	4
2	January 1, 1991	Mercantile Credit Building	Basingstoke	UK	n.a.	n.a.	3
3	April 5, 1991	Knowsley Heights	Liverpool	UK	0	0	n.a.
4	September 6, 1993	Sun Valley Poultry Factory	Hereford	UK	2	n.a.	n.a.

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-3: High-rise façade fires in 1995-1999.

N	Date	Building	City	Country	D	I	AF
1	April 11, 1996	Düsseldorf Airport fire	Düsseldorf	Germany	17	62-88	n.a.
2	October 28, 1996	Motomachi Apartments	Hiroshima	Japan	0	2	12
3	September 30, 1997	Eldorado Hotel	Reno	USA	0	0	n.a.
4	June 20, 1998	Palace Station Hotel	Las Vegas	USA	0	0	n.a.
5	June 11, 1999	Garnock Court	Irvine	Scotland	1	4	7

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-4: High-rise façade fires in 2000-2004.

N	Date	Building	City	Country	D	I	AF
1	June 2, 2002	Tip Top Bakery	Fairfield	Australia	0	1	n.a.
2	July 29, 2003	Telstar House	London	UK	0	3	4
3	October 17, 2004	Parque Central Complex	Caracas	Venezuela	0	25	17

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-5: High-rise façade fires in 2005-2009.

N	Date	Building	City	Country	D	I	AF
1	February 12, 2005	Windsor Tower	Madrid	Spain	0	7	32
2	April 21, 2005	Residential block Pankow	Berlin	Germany	2	3	5
3	September 23, 2007	Water Club Tower	Atlantic City	USA	n.a.	n.a.	39
4	January 25, 2008	MGM Monte Carlo Hotel	Las Vegas	USA	n.a.	n.a.	4
5	May 9, 2008	De Punt fire	De Punt	Netherlands	3	o	n.a.
6	February 9, 2009	TV Cultural Center	Beijing	China	1	7	44
7	July 3, 2009	Lakanal House	London	UK	6	20	n.a.
8	August 15, 2009	Residential Block	Miskolc	Hungary	3	n.a.	6

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-6: High-rise façade fires in 2010-2014.

N	Date	Building	City	Country	D	I	AF
1	July 6, 2010	Al Kuwait Tower	Sharjah	UAE	n.a.	n.a.	10
2	September 1, 2010	Wooshin Golden Suites	Busan	South Korea	0	5	35
3	November 14, 2010	4 Rue du Lac Flats	Dijon	France	7	11	n.a.
4	November 15, 2010	Jiaozhou Road	Shanghai	China	58	71	28
5	February 3, 2011	Royal Wanxin Hotel	Shenyang	China	n.a.	n.a.	n.a.
6	January 18, 2012	Al Baker Tower	Sharjah	UAE	n.a.	n.a.	n.a.
7	April 28, 2012	Al Tayer Tower	Sharjah	UAE	0	0	n.a.
8	May 14, 2012	Mermoz Tower	Roubaix	France	1	6	17
9	July 17, 2012	Polat Tower	Istanbul	Türkiye	0	0	n.a.
10	October 6, 2012	Saif Belhasa Building	Dubai	UAE	0	2+	9
11	November 18, 2012	Tamweel Tower	Dubai	UAE	0	0	n.a.
12	April 3, 2013	Grozny-City Tower	Chechnya	Russia	0	0	40

N	Date	Building	City	Country	D	I	AF
13	April 22, 2013	Al Hafeet Tower	Sharjah	UAE	0	n.a.	10
14	September 21, 2014	Krasnoyarsk Apartments	Krasnoyarsk	Russia	0	n.a.	25
15	November 25, 2014	Lacrosse Building	Melbourne	Australia	0	0	16

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-7: High-rise façade fires in 2015-2019.

N	Date	Building	City	Country	D	I	AF
1	February 21, 2015	The Marina Torch	Dubai	UAE	0	7	60
2	May 19, 2015	Baku Residential	Baku	Azerbaijan	16	63	n.a.
3	October 1, 2015	Al Nasser Tower	Sharjah	UAE	0	40	26
4	December 31, 2015	Address Downtown Hotel	Dubai	UAE	0	15	n.a.
5	March 28, 2016	Ajman One Complex	Ajman	UAE	0	n.a.	n.a.
6	July 20, 2016	Sulafa Tower	Dubai	UAE	0	n.a.	30
7	August 19, 2016	Shepherds Court	London	UK	0	1	3
8	November 9, 2016	Neo Soho Project	Jakarta	Indonesia	0	0	7
9	December 1, 2016	Al Bandary Tower B	Sharjah	UAE	0	4	n.a.
10	December 13, 2016	Oceana Adriatic Building	Dubai	UAE	0	0	n.a.
11	May 3, 2016	Longsheng Building	Nanjing	China	0	0	n.a.
12	March 2, 2017	Address Residences	Dubai	UAE	0	0	3
13	June 14, 2017	Grenfell Tower	London	UK	72	70	24
14	August 4, 2017	The Marina Torch	Dubai	UAE	0	0	64/87
15	February 1, 2018	Yuansheng International	Zhengzhou	China	0	n.a.	20
16	April 5, 2018	Taksim Ilk Yardim Hospital	Istanbul	Türkiye	0	0	14
17	May 15, 2018	Zen Tower	Dubai	UAE	0	0	15
18	February 4, 2019	Neo 200	Melbourne	Australia	0	0	6
19	March 14, 2019	Kaifeng Apartments	Kaifeng	China	0	n.a.	17
20	May 27, 2019	Golden Eagle Shopping Mall	Nanjing	China	0	0	1
21	May 29, 2019	Commercial Building	Luoyang	China	0	0	3rd floor / roof
22	August 14, 2019	Residential Flats	Warsaw	Poland	n.a.	n.a.	10
23	November 16, 2019	The Cube Student Housing	Bolton	UK	0	2	1

Note: D – fire death, I – injuries, AF – affected floors.

Table 9.0-8: High-rise façade fires in 2020-2024.

N	Date	Building	City	Country	D	I	AF
1	May 5, 2020	Abbco Tower	Sharjah	UAE	0	12	48
2	July 27, 2020	Business Centre	Ankara	Türkiye	0	n.a.	n.a.
3	August 29, 2020	Madrid Tower Block	Madrid	Spain	0	n.a.	3
4	October 8, 2020	Apartment Block	Ulsan	South Korea	0	91	33
5	March 9, 2021	Apartment Building	Shijiazhuang	China	0	0	26
6	August 29, 2021	Torre dei Moro	Milan	Italy	0	0	20
7	November 7, 2022	Apartment Building	Dubai	UAE	0	0	35

8	February 22, 2024	Residential complex	València	Spain	10	15	14

Note: D – fire death, I – injuries, AF – affected floors.

Fires on building façades in general and in high-rise buildings in particular are a worrying phenomenon. Until 2016, only a few nations collected detailed information about façade fires in general and high-rise buildings in particular. The impression then arises that some states do not disclose the data collected.

Façade fires do not occur often compared to other large building fires. But the potential for damage can be very high. Most fires occur in countries with poor regulatory controls or where the structure does not comply with regulations. Common fire scenarios include:

- Scenario A: The fire spreads from the neighboring structure to the building.
- Scenario B: The fire spreads from an external source adjacent to the façade and different from the neighboring building, e.g., a vehicle fire, a fire in a garbage container, etc. It can also be a source of fire in the balcony area.
- Scenario C: Vertical fire spread between the openings of a fully developed fire within a building. At least one opening or pure defect in the façade is sufficient. [139]

In the source just mentioned, there is an interesting comparison of two high-rise fires (Table 9.0-9).

Table 9.0-9: Comparison of two high-rise fires.

	Grenfell Tower, London	**The Torch, Dubai**
Height [m]	67.3	336.8
Number of floors	24	79
Number of apartments	127	676
Start of operation	1974 (renovated in 2015–2016).	2011
Fire event	Juni 14, 2017	February 21, 2015, (second façade fire happen August 4, 2017).
Number of deaths	72	0
Number of wounded	74	0
Fire alarm worked?	non-functionally	It worked
Fire under control	24 hours	2 hours

The statistical data is poor. As a result, only overviews, as described in Table 9.0-2 to Table 9.0-8, are currently available.

Only comparatively detailed data are available from the USA: For all building types analyzed, exterior wall fires accounted for 3% of all structure fires, 3% of civilian deaths and injuries, and 8% of property damage. 42% of the fires started on the exterior wall surface, 32% where the item first ignited was exterior wall covering, and 26% where the item contributing most to fire spread was an exterior wall.

[139] Anton OSVALD1, Jaroslav FLACHBART: FIRES FACADE OF THE SKYSCRAPER, Žilinska Univerzita, KRÍZOVÝ MANAŽMENT - 2/2017, ISSN:1336 - 0019, pp. 55-63.

On the other hand, research is needed to better understand the façade fire phenomenon. This is mainly about flame spread (vertically and horizontally), flame spread (inside the building), the connection point between floor and façade, smoldering, falling debris, smoke, heat, and detailing (window openings, balcony, etc.).

In this context, two papers should be mentioned that deal with the question of testing building façades. Several test procedures are used, and the results of these tests may have different practical implications.

The report [140] summarizes experimental and modeling efforts in characterizing the fire safety of façades using the Swedish SP Fire 105 and the British BS 8414 methods. Recent experimental results and modeling are presented, exploring the variations in the fire exposure, fire load, and fuel used. Additional temperatures measured by plate thermometers characterize the fire source and the heat exposure to the façade. At the same time, some other aspects are only treated in the numerical study, such as a change in fuel. It is found that the results from BS 8414 are primarily affected by wind and climate since the experimental test was performed outdoors. Moreover, the spread of fire on wooden façades is also briefly discussed.

A project was initiated to develop a uniform test procedure. [141] "Finalization of the European approach to assess the fire performance of façades" aims to finalize the methodology for assessing the fire performance of façades. The project's outcome is a European approach to evaluate the fire performance of façades.

Among many results selected in the final report, the wind significantly influences both the flame height and the temperatures under experimental conditions. As an outside observer, one can consistently confirm this finding by looking at images and video recordings of real fires. An important question remains unanswered: Why are flammable materials used even though the associated risks have been known for years?

Resumé:

- Do we really need to use flammable materials in the façade of high-rise buildings, considering the potential catastrophic consequences?
- Why should the façade problems be shifted from architects, planners, and local administration to the fire brigades, when a collaborative approach could be more effective?
- Are local administrations aware that combustible façade elements are a ticking time bomb, and that fire brigades have limited technical options for firefighting, potentially leading to catastrophic outcomes?

[140] Johan Andersson, Lars Boström and Robert Jansson McNamee: Fire Safety of Facades, RISE Research Institutes of Sweden, SP Rapport 2017:37, ISSN 0284-5172.
[141] https://www.ri.se/sites/default/files/2024-10/Final%20Report_Final.pdf

10.0 Special Case Study: Berlin (Germany)

10.01 German High-rise Guidelines

According to German guidelines, buildings with at least one recreation room's floor more than 22 meters above the specified ground surface are generally considered high-rise buildings.

The high-rise guidelines may vary in detail in the individual German federal states. Some German federal states have introduced the Model High-Rise Directive (MHHR) directly by the building authorities. In other federal states, there is no corresponding legal provision; here, the validity of the model directive is specified in the building permit, or each requirement is listed as an ancillary provision. On January 1, 2014, the federal state of Hesse introduced its high-rise directive, which differs from the MHHR in some details. In North Rhine-Westphalia, the MHHR has also not remained unchanged but has been incorporated into the Special Building Ordinance in an edited form with some simplifications.

The justification for this definition is based on the fundamental requirement for two independent escape routes for each recreation room and the principle that the second escape route may lead via the rescue equipment of the fire brigade. The largest rescue device standardized in Germany is a turntable ladder (DLK 23/12) with a nominal rescue height of 23 meters (the parapet height must be added to the height of the floor to reach the required rescue height). Therefore, the rescue equipment of the fire brigades is excluded from the second escape route, which is why special measures are necessary (second structural escape route, safety stairwell, etc.). In 2022, the federal state of Berlin raised the high-rise limit to 25 m.

In the following, we will quote only essential parts of the multi-layered argumentation regarding the structural features of high-rise buildings. As the height of a building increases, problems and risks arise that do not occur with low houses. In particular, the following should be mentioned:

- The firefighters' attack paths become longer until a point is reached at which the extinguishing success becomes questionable. A firefighter who first has to overcome 50 meters of altitude with equipment weighing 20 to 30 kilograms lacks the power reserves for the extinguishing attack. Therefore, a fire brigade elevator is usually required from a height of 30 meters.
- The transport of extinguishing water becomes more difficult and, at some point, even impossible with the fire brigade's means. The technical possibilities of the hose material and pump outlet pressure are limited. Therefore, for high-rise buildings, dry and/or wet risers are required, sometimes with booster pumps.
- Firefighting in high-rise buildings poses particular difficulties for the fire brigade. Therefore, the spread of fires must be prevented. The high-rise directives contain regulations that go beyond the normal regulations. In particular, the laying of cables (pipelines, electrical cables, telecommunications lines, requirements for building materials, and more) is subject to increased requirements.

- It is becoming increasingly unlikely that all residents will notice a fire and the associated fire brigade operation in tall buildings. For this reason, warning devices (e.g., an electric loudspeaker system) may be required.
- The higher the number of people in relation to the floor area, the higher the risk. Therefore, fire extinguishing systems, fire alarm systems, or manual fire extinguishers are required from certain building heights.
- In contrast to the building regulations, the high-rise directives also contain operating regulations.

10.02 Fire victims in Berlin (Germany)

For a deeper understanding of the fire situation in buildings in general and in high-rise buildings in particular, we refer to an elaboration from Berlin (Germany). The question of the victims to be mourned in fires is in the foreground. [142] [143] [144]

In a defined sample of 5,471 fire operations between 1997 and 2015, the statistical distribution of 18,117 fire victims is examined. That is a subset of the official statistics of the state of Berlin or the annual reports of the Berlin Fire Department. The term "fire victim" is defined as follows. Fire victims are understood to be all persons affected by a fire who were registered during the fire brigade's fire operations, whereby a distinction is made between three categories:

- "**Persons brought to safety**" were brought to safety in the fire object by the fire brigade or rescued themselves, without burn injuries.
- "**Smoke gas poisoned and injured persons**" were rescued injured by the fire brigade or rescued themselves injured.
- "**Lifeless persons**" were found by the fire brigade during or after the firefighting in the fire object.

Two limitations should be noted for the sample: For 2004, the data for August and September are missing; in 2015, the data only covers the period up to the end of August. The present sample describes fire operations in which at least one victim was registered:

- 9,436 "**Persons brought to safety**",
- 8,186 "**Smoke gas poisoned/injured persons**" and
- 495 "**Lifeless Persons**" (Figure 10.02-1).

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[142] Peter Wagner, Harald Herweg: Brandopfer in Berlin – Teil 1: Faktor Zeit, vfdb 2/2018 (pp. 75-97).
[143] Peter Wagner, Harald Herweg: Brandopfer in Berlin – Teil 2: Faktor Raum, vfdb 4/2019 (pp. 150-174).
[144] Harald Herweg, Peter Wagner: Brandopfer in Berlin – Teil 3: Faktor Brandobjekt, 2021/4: (In welchen Brandobjekten sind Brandopfer am häufigsten zu erwarten?), 2022/1 (Auf welche Brandobjekte verteilen sich Opferbrände an sich und dabei registrierte Brandopfer?), 2022/2: (Wie verteilen sich die relativen Opferzahlen der Opfergruppen auf die einzelnen Brandobjekte?).

The list of Berlin high-rise buildings (Section 4.04) shows that the average floor height is 3.3 m. At the high-rise boundary of 25 m, this corresponds to the 7th floor.

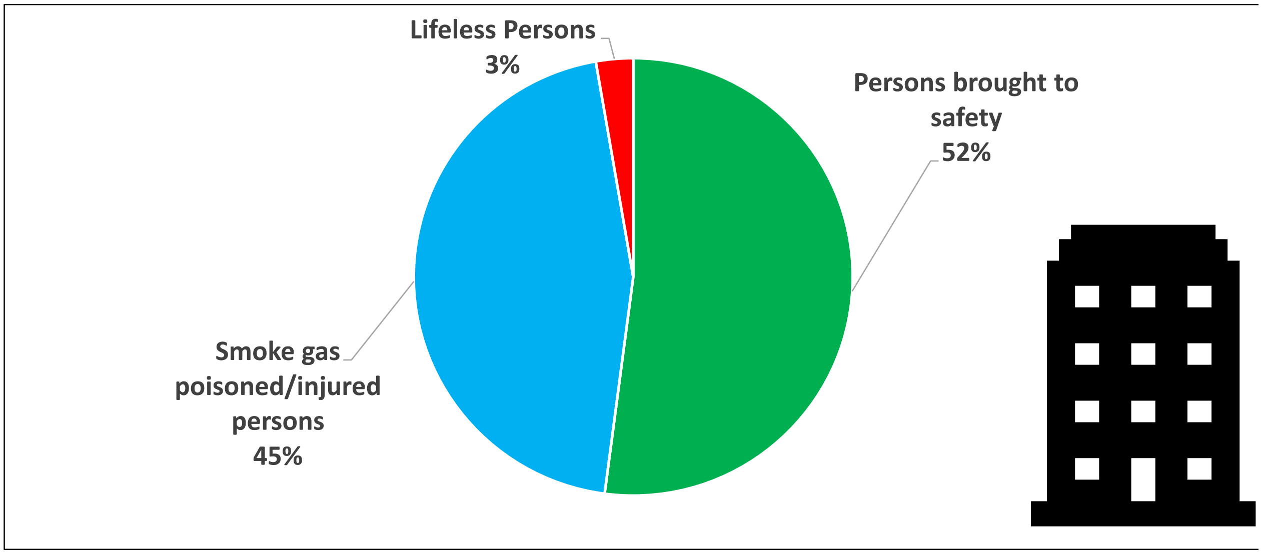

Figure 10.02-1: Distribution of total number of victims by categories for all fire victims in the sample.

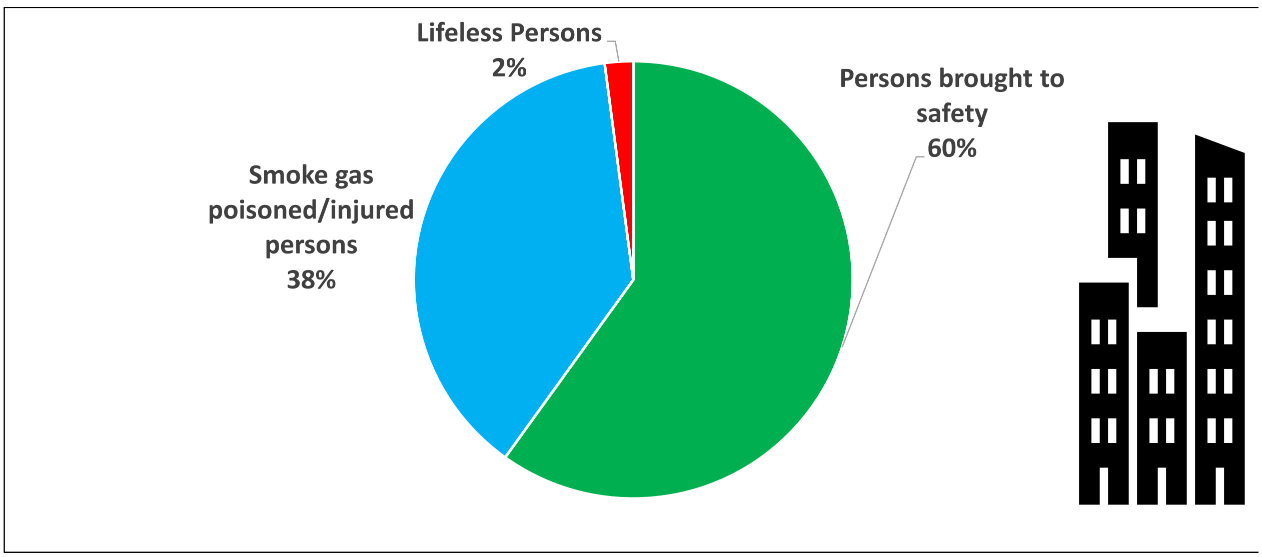

Figure 10.02-2: Distribution of victims by categories for all fire victims in high-rise buildings only.

Figure 10.02-2 specifies the distribution of the victims and the number of fires in high-rise buildings (7 or more floors).

The comparison of Figures 10.02-1 and 10.02-2 does not show a remarkably different distribution of the groups of victims.

At the beginning, we compare the distribution of the fires with the number of victims. The respective number of floors of the fire object is indicated (Figure 10.02-3). Unfortunately, it is not clear from the database which floor the fire broke out or where the victims were. It should be noted that of the total of

5471 fires, 80.6% were registered in buildings with up to 6 floors. High-rise buildings thus account for 19.4% of fire incidents.

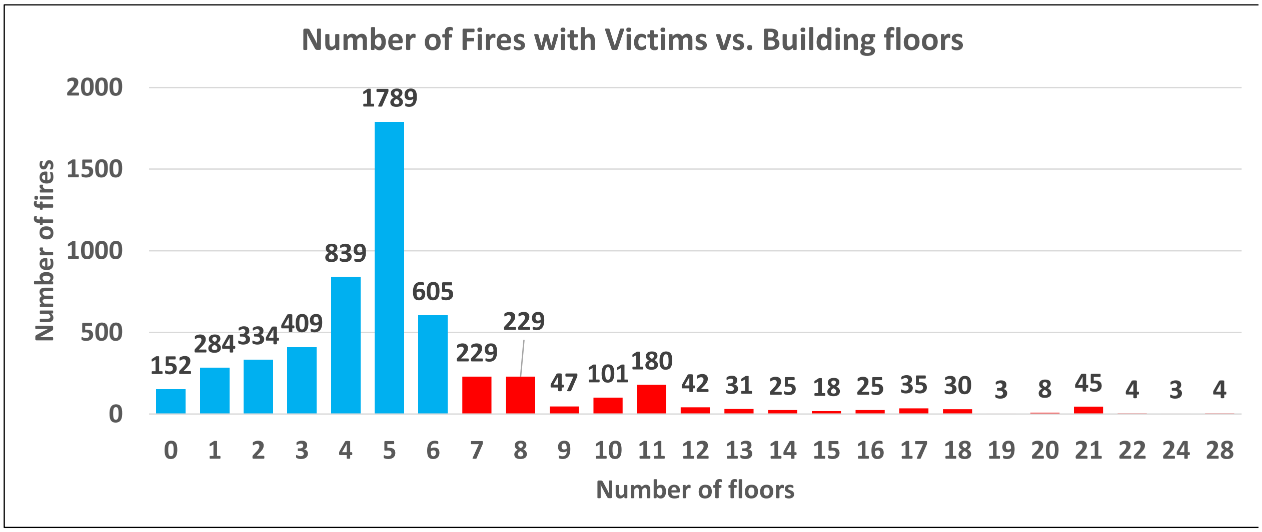

Figure 10.02-3: Distribution of fires with fire victims on the number of floors of the buildings.

10.02.1 Total victims

Now, let's look at the total number of fire victims. That is the sum of all rescued, injured, and lifeless persons found at the scene of the fire. From 1997 to 2015, 18,117 people were registered as fire victims or affected persons.

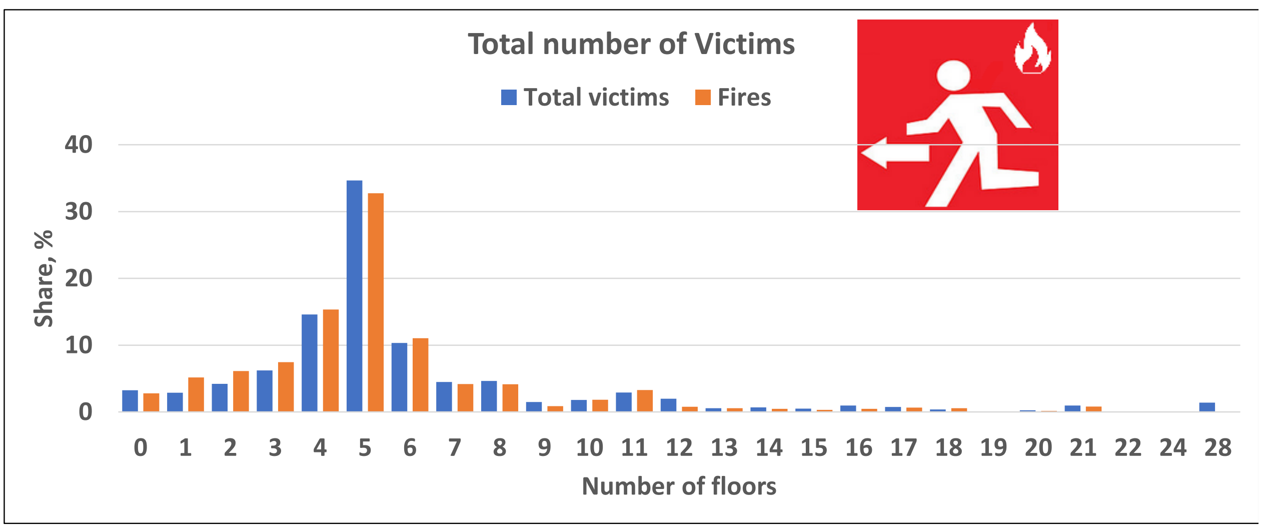

Figure 10.02.1-1: Distribution of total number of victims and fires on fire objects according to their respective number of floors (Share in %).

Figure 10.02.1-1 shows that most fire victims were registered in buildings with up to 6 floors (76.2%). The distribution of the fires is similar to the distribution of the number of fires. That is then 80.7% of all fires. Thus, high-rise buildings account for 23.8% of the victims and 19.3% of the fires.

Table 10.02.1-1: Distribution of the **total number of victims** in high-rise fires by building type and number of floors.

Floors	Residential	Dormitory	Industry, Commercial	Hotel, hostel	Health facility	Sales outlets	Administration	Other building	Special	Σ	%
7	600	173	10	6	12	7	2	0	1	**811**	**18.8**
8	610	74	135	15	3	1	3	1	1	**843**	**19.5**
9	228	0	1	41	0	0	0	1	0	**271**	**6.3**
10	301	22	3	2	0	0	0	0	0	**328**	**7.6**
11	513	8	1	2	0	2	0	0	0	**526**	**12.2**
12	351	3	0	0	2	2	0	0	0	**358**	**8.3**
13	98	1	0	0		3	0	0	0	**102**	**2.4**
14	123	0	0	0	0	0	0	0	0	**123**	**2.9**
15	87	3	0	1	0	0	0	0	0	**91**	**2.1**
16	172	1	0	0	0	0	0	0	0	**173**	**4.0**
17	134	0	0	0	0	0	0	0	0	**134**	**3.1**
18	67	0	0	2	0	0	0	0	0	**69**	**1.6**
19	3	0	0	0	0	0	0	0	0	**3**	**0.1**
20	43	0	0	3	0	0	0	0	0	**46**	**1.1**
21	172	0	0	0	0	0	0	0	0	**172**	**4.0**
22	4	0	3	0	0	0	0	0	0	**7**	**0.2**
24	4	0	0	0	0	0	0	0	0	**4**	**0.1**
28	254	0	0	0	0	0	0	0	0	**254**	**5.9**
Sum	**3,764**	**285**	**153**	**72**	**17**	**15**	**5**	**2**	**2**	**4,315**	**100**
%	**87.2**	**6.6**	**3.5**	**1.7**	**0.4**	**0.3**	**0.1**	**0.0**	**0.0**	**100**	**-**

Let us now take a closer look at the high-rise buildings. Table 10.02.1-1 shows the distribution of the total number of victims in high-rise fires by building type and number of floors. Regarding floors, 7-story buildings account for 18.8% of victims, 8-story buildings for 19.5%, and 11-story high-rise buildings for 12.2%. The respective shares are in the single-digit range for all other high-rise buildings. Looking at the primary use of buildings, residential high-rises (87.2%) lead the way, followed by dormitories (6.6%) and high rises "Industry, Commercial" (3.5%).

Figure 10.02.1-2 illustrates the ratio of victims to the number of fires. The values about the number of floors of the fire objects are between 1.0 (buildings with 19 floors) and 8.5 (buildings with 12 floors), i.e., both values in the "high-rise buildings" category). A statistical outlier is the value for buildings with 28 floors (254 people in 4 fires).

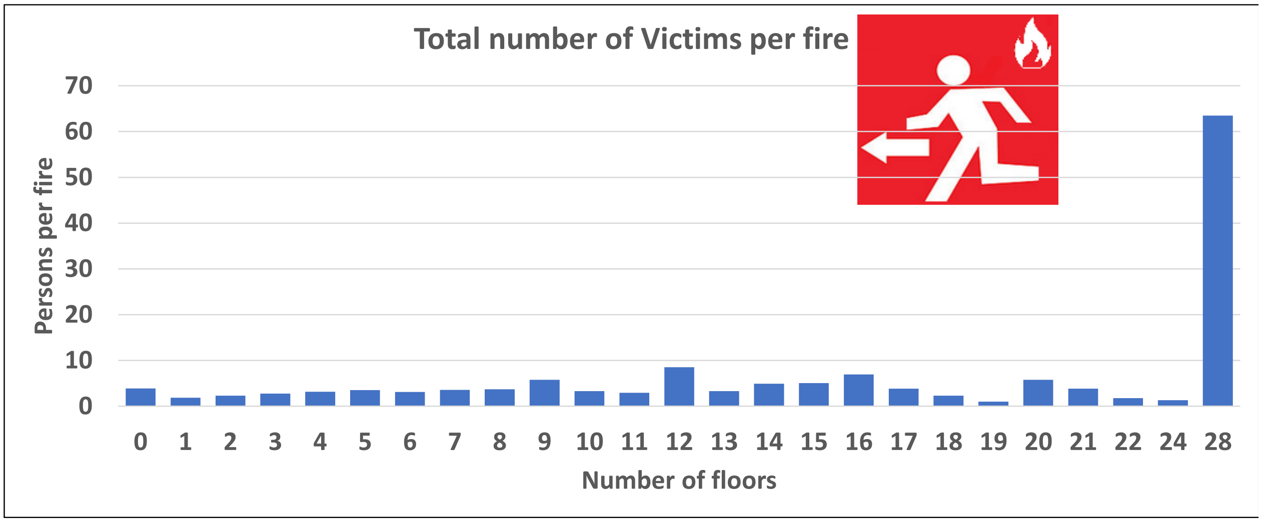

Figure 10.02.1-2: Number of fire victims per fire according to their respective number of floors.

Table 10.02.1-2: Distribution of the total **number of victims** by type of high-rise building and floor spacing.

Types of high-rise buildings	Absolute number of victims by floors						Share of victims (%) by floors					
	≤10	11-20	21-30	31-50	>50	Sum	≤10	11-20	21-30	31-50	>50	Sum
Residential	1,739	1,591	434	0	0	**3,764**	40.3	36.9	10.1	0.0	0.0	**87.2**
Dormitory	269	16	0	0	0	**285**	6.2	0.4	0.0	0.0	0.0	**6.6**
Industry, Commercial	149	1	3	0	0	**153**	3.5	0.0	0.1	0.0	0.0	**3.5**
Hotel, hostel	64	8	0	0	0	**72**	1.5	0.2	0.0	0.0	0.0	**1.7**
Health facility	15	2	0	0	0	**17**	0.3	0.0	0.0	0.0	0.0	**0.4**
Sales outlets	8	7	0	0	0	**15**	0.2	0.2	0.0	0.0	0.0	**0.3**
Administration	5	0	0	0	0	**5**	0.1	0.0	0.0	0.0	0.0	**0.1**
Other building	2	0	0	0	0	**2**	0.0	0.0	0.0	0.0	0.0	**0.0**
Buildings, general	2	0	0	0	0	**2**	0.0	0.0	0.0	0.0	0.0	**0.0**
Sum	**2,253**	**1625**	**437**	**0**	**0**	**4,315**	**52.2**	**37.7**	**10.1**	**0.0**	**0.0**	**100**

Table 10.02.1-2 illustrates the distribution of the **victims** by type of high-rise building and floor spacing. The number of floors of the high-rise buildings follows the intervals already applied in section 4. The table shows that 52% of all victims are found in buildings of up to 10 floors. Another 38% find themselves in the interval 11-10 floors. The remaining 10% is accounted for by high-rise buildings with 21-30 floors. Regarding the type of use of high-rise buildings, residential buildings are in first place (87%). All other types of use of high-rise buildings are in the single-digit range in proportion to the number of victims.

10.02.2 Smoke gas poisoned/injured persons

"**Smoke gas poisoned and injured persons**" were rescued injured by the fire brigade or rescued themselves injured. The total number of persons in the study was 8,186.

Figure 10.02.2-1 shows the distribution of "**Smoke gas poisoned and injured persons**" and fires on fire objects according to their respective number of floors. Around 80% of the victims and fires are in the area of up to 6 floors, i.e., below the high-rise boundary. On average, 1.8 victims were registered by fire (Figure 10.02.2-2). Only in the case of high-rise fires (28 floors) is the average number of victims significantly higher.

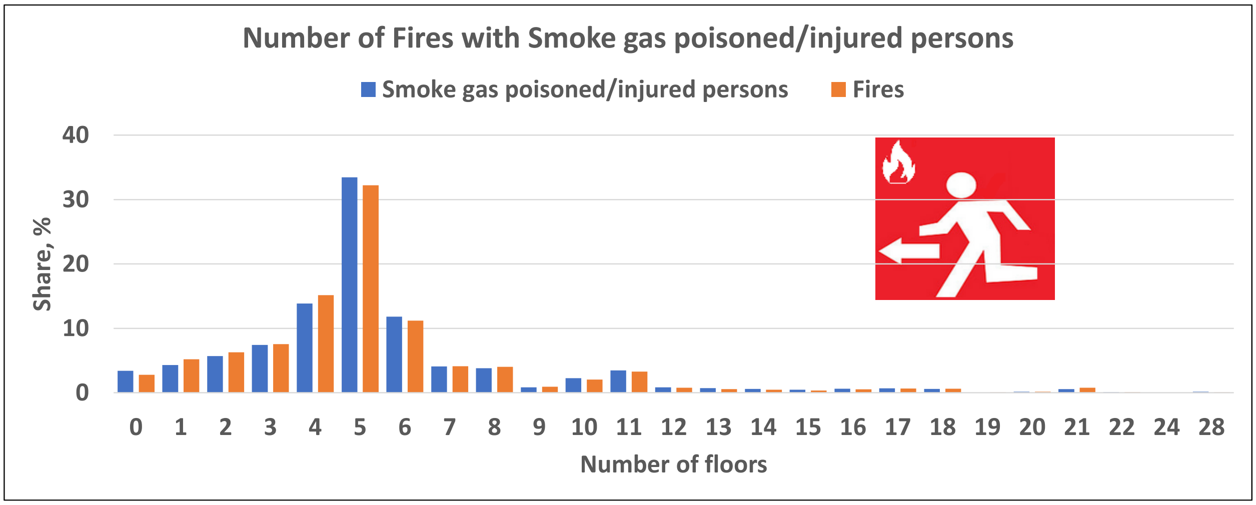

Figure 10.02.2-1: Distribution of "Smoke gas poisoned and injured persons" and fires on fire objects according to their respective number of floors (Share in %).

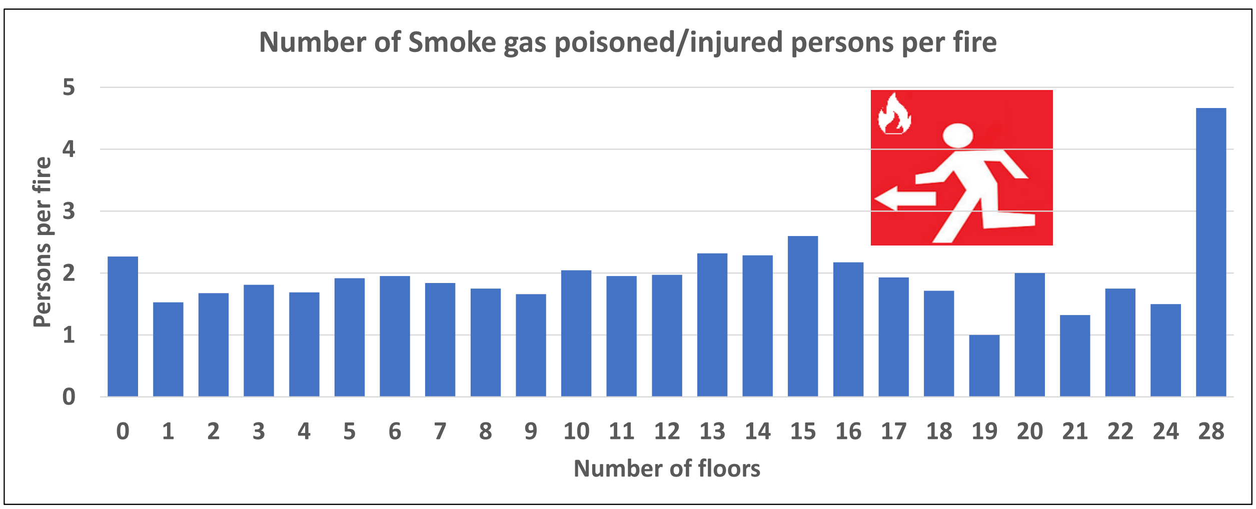

Figure 10.02.2-2: Number of "Smoke gas poisoned and injured persons" per fire according to their respective number of floors.

Table 10.02.2-1: Distribution of the number of **Smoke gas poisoned/injured persons** in high-rise fires by building type and number of floors.

Floors	Residential	Dormitory	Industry/Commercial Buildings	Hotel, hostel	Sales outlets	Health facility	Administration	Buildings, general	Other building	Σ	%
7	273	37	9	6	7	0	2	1	0	**335**	**20.4**
8	273	23	5	3	1	3	3	1	1	**313**	**19.1**
9	65	0	1	1	0	0	0	0	1	**68**	**4.1**
10	176	3	3	2	0	0	0	0	0	**184**	**11.2**
11	280	3	1	0	1	0	0	0	0	**285**	**17.4**
12	62	3	0	0	2	2	0	0	0	**69**	**4.2**
13	56	1	0	0	1	0	0	0	0	**58**	**3.5**
14	48	0	0	0	0	0	0	0	0	**48**	**2.9**
15	35	3	0	1	0	0	0	0	0	**39**	**2.4**
16	49	1	0	0	0	0	0	0	0	**50**	**3.1**
17	56	0	0	0	0	0	0	0	0	**56**	**3.4**
18	46	0	0	2	0	0	0	0	0	**48**	**2.9**
19	3	0	0	0	0	0	0	0	0	**3**	**0.2**
20	11	0	0	3	0	0	0	0	0	**14**	**0.9**
21	45	0	0	0	0	0	0	0	0	**45**	**2.7**
22	4	0	3	0	0	0	0	0	0	**7**	**0.4**
24	3	0	0	0	0	0	0	0	0	**3**	**0.2**
28	14	0	0	0	0	0	0	0	0	**14**	**0.9**
Sum	**1,499**	**74**	**22**	**18**	**12**	**5**	**5**	**2**	**2**	**1,639**	**100**
%	**91.5**	**4.5**	**1.3**	**1.1**	**0.7**	**0.3**	**0.3**	**0.1**	**0.1**	**100**	

Table 10.02.2-2: Distribution of the **Smoke gas poisoned/injured persons** by type of high-rise building and floor spacing.

Number of Floors	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum**	**≤10**	**11-20**	**21-30**	**31-50**	**>50**	**Sum**
Residential	787	646	66	0	0	**1,499**	48,0	39,4	4,0	0,0	0,0	**91.5**
Dormitory	63	11	0	0	0	**74**	3,8	0,7	0,0	0,0	0,0	**4.5**
Industry/Commercial Buildings	18	1	3	0	0	**22**	1,1	0,1	0,2	0,0	0,0	**1.3**
Hotel, hostel	12	6	0	0	0	**18**	0,7	0,4	0,0	0,0	0,0	**1.1**
Sales outlets	8	4	0	0	0	**12**	0,5	0,2	0,0	0,0	0,0	**0.7**
Health facility	3	2	0	0	0	**5**	0,2	0,1	0,0	0,0	0,0	**0.3**
Administration	5	0	0	0	0	**5**	0,3	0,0	0,0	0,0	0,0	**0.3**
Buildings, general	2	0	0	0	0	**2**	0,1	0,0	0,0	0,0	0,0	**0.1**
Other building	2	0	0	0	0	**2**	0,1	0,0	0,0	0,0	0,0	**0.1**
Sum	**900**	**670**	**69**	**0**	**0**	**1,639**	**54,9**	**40,9**	**4,2**	**0,0**	**0,0**	**100**

Now, let us also concentrate on the high-rise fires. Table 10.02.2-1 illustrates the distribution of the number of **Smoke gas poisoned/injured persons** in high-rise fires by building type and number of floors. Of the total of 1,639 Smoke-poisoned/injured persons, 91% are residential buildings.

Table 10.02.2-2 provides the distribution of the **Smoke gas poisoned/injured persons** by high-rise building type and floor spacing. The subdivision of the building floors is carried out as already applied in section 4. The result shows that 55% of the victims were registered in high-rise buildings with up to 10 floors. In another 41%, there were high-rise buildings with 11-20 floors. The values are in the single-digit range for buildings with a larger number of floors. Regarding building type, residential high-rises stand out clearly with 91%.

10.02.3 Persons brought to safety

We also look at "**Persons brought to safety**." The fire brigade brought that group of victims to safety in the fire object or rescued themselves without burn injuries. In total, there were 9,436 people in 1,358 fires. Around 73% of the victims and the fires (80%) are in an area of up to 6 floors, i.e., below the high-rise boundary. On average, 6.9 victims were registered by fire (Figure 10.02.2-2). Only in the case of high-rise fires (28 floors) is the average number of victims significantly higher.

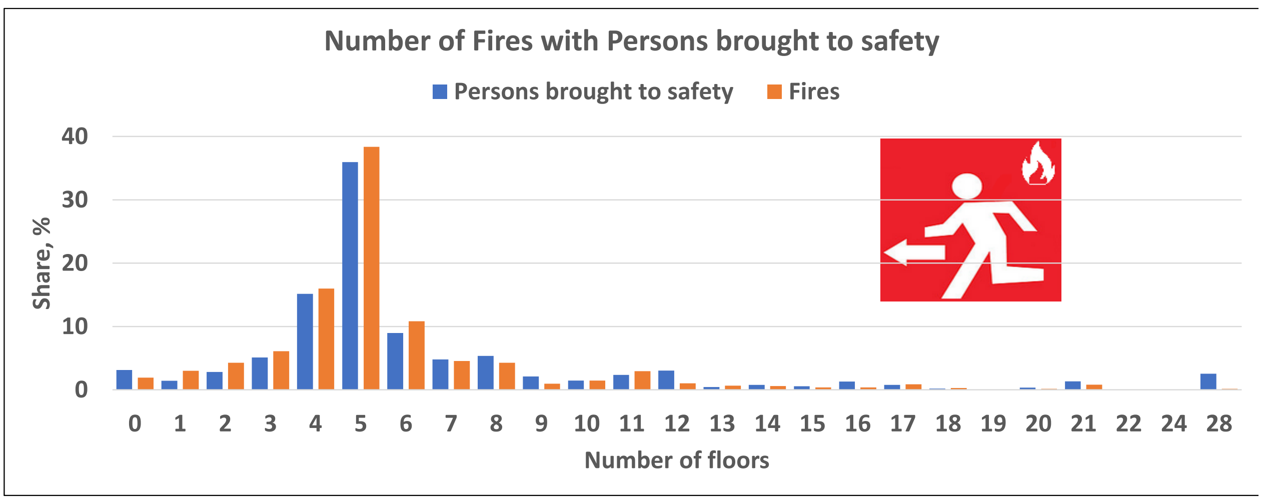

Figure 10.02.3-1: Distribution of "Persons brought to safety" and fires on fire objects according to their respective number of floors (Share in %).

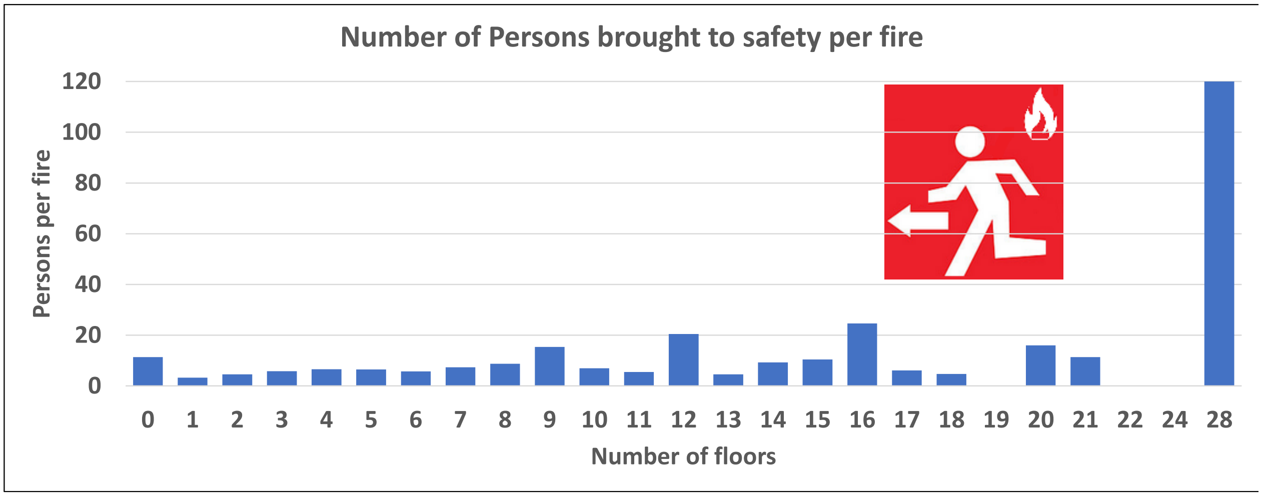

Figure 10.02.3-2: Number of "Persons brought to safety" per fire according to their respective number of floors.

Table 10.02.3-1: Distribution of the number of **persons brought to safety** in high-rise fires by building type and number of floors.

Floors	Residential	Dormitory	Industry, Commercial	Hotel, hostel	Health facility	Sales outlets	Σ	%
7	312	129	1	0	12	0	454	17.6
8	318	45	130	12	0	0	505	19.5
9	160	0	0	40	0	0	200	7.7
10	120	19	0	0	0	0	139	5.4
11	214	5	0	2	0	0	221	8.5
12	287	0	0	0	0	0	287	11.1
13	39	0	0	0	0	2	41	1.6
14	74	0	0	0	0	0	74	2.9
15	52	0	0	0	0	0	52	2.0
16	123	0	0	0	0	0	123	4.8
17	73	0	0	0	0	0	73	2.8
18	19	0	0	0	0	0	19	0.7
19	0	0	0	0	0	0	0	0.0
20	32	0	0	0	0	0	32	1.2
21	125	0	0	0	0	0	125	4.8
22	0	0	0	0	0	0	0	0.0
24	0	0	0	0	0	0	0	0.0
28	240	0	0	0	0	0	240	9.3
Sum	2,188	198	131	54	12	2	2,585	100
%	84.6	7.7	5.1	2.1	0.5	0.1	100	

Table 10.02.3-2: Distribution of the **persons brought to safety** by type of high-rise building and floor spacing.

Types of buildings	Number of Floors											
	≤10	11-20	21-30	31-50	>50	∑	≤10	11-20	21-30	31-50	>50	%
Residential	910	913	365	0	0	**2,188**	35.2	35.3	14.1	0.0	0.0	**84.6**
Dormitory	193	5	0	0	0	**198**	7.5	0.2	0.0	0.0	0.0	**7.7**
Industry/ Commercial	131	0	0	0	0	**131**	5.1	0.0	0.0	0.0	0.0	**5.1**
Hotel, hostel	52	2	0	0	0	**54**	2.0	0.1	0.0	0.0	0.0	**2.1**
Health facility	12	0	0	0	0	**12**	0.5	0.0	0.0	0.0	0.0	**0.5**
Sales outlets	0	2	0	0	0	**2**	0.0	0.1	0.0	0.0	0.0	**0.1**
Sum	**1,298**	**922**	**365**	**0**	**0**	**2,585**	**50.2**	**35.7**	**14.1**	**0.0**	**0.0**	**100.0**

How we focus attention on the high-rise fires. Table 10.02.3-1 illustrates the distribution of the number of **persons brought to safety** in high-rise fires by building type and number of floors. Of the 2,585 persons, 85% were rescued from residential buildings. 50% of all victims come from high-rise buildings with up to 10 floors.

Table 10.02.3-2 provides the distribution of the **persons brought to safety** by type of high-rise building and floor spacing. The subdivision of the building floors is carried out as already applied in section 4. The result shows that 50% of the victims were registered in high-rise buildings with up to 10 floors. In another 36%, there were high-rise buildings with 11-20 floors. Regarding building type, residential high-rises stand out clearly with 85%.

10.02.4 Lifeless persons

Probably the most interesting part of the sample analysis is the consideration of the "**lifeless persons found**" in general and high-rise fires in particular. A total of 495 "**lifeless persons**" were found by the fire brigade at the fire scene in the cases considered in the sample. Persons who later died in hospital are not part of the examination.

Figure 10.02.4-1 shows that most fire victims were registered in buildings with up to 6 floors (81.6%). The distribution of the fires is similar to the distribution of the number of fires. That is then 80.7% of all fires. Thus, high-rise buildings account for 18.4% of the victims and 19.3% of the fires.

On average, 1.08 victims were registered by fire (Figure 10.02.4-2).

How we focus attention on the high-rise fires. Table 10.02.4-1 illustrates the distribution of the number of **lifeless persons** in high-rise fires by building type and number of floors. Of the 90 persons, 85.6% were found in residential buildings. All other lifeless persons found in dormitory fires (13 persons, 14.4%). 24.4% of all victims come from high-rise buildings with up to 10 floors.

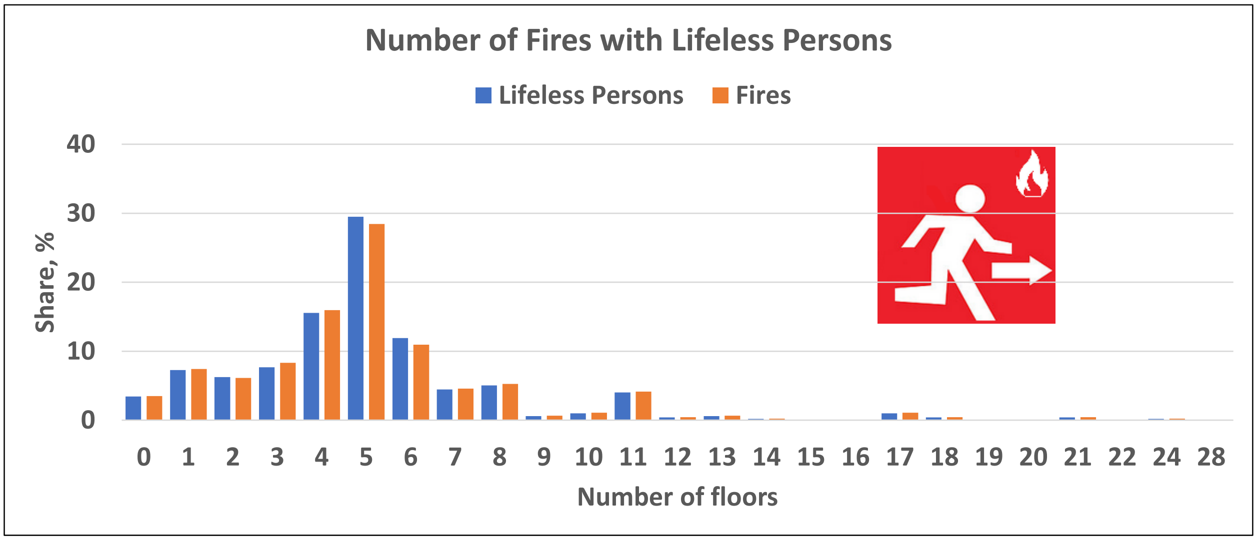

Figure 10.02.4-1: Distribution of "Lifeless Persons" and fires on fire objects according to their respective number of floors (Share in %).

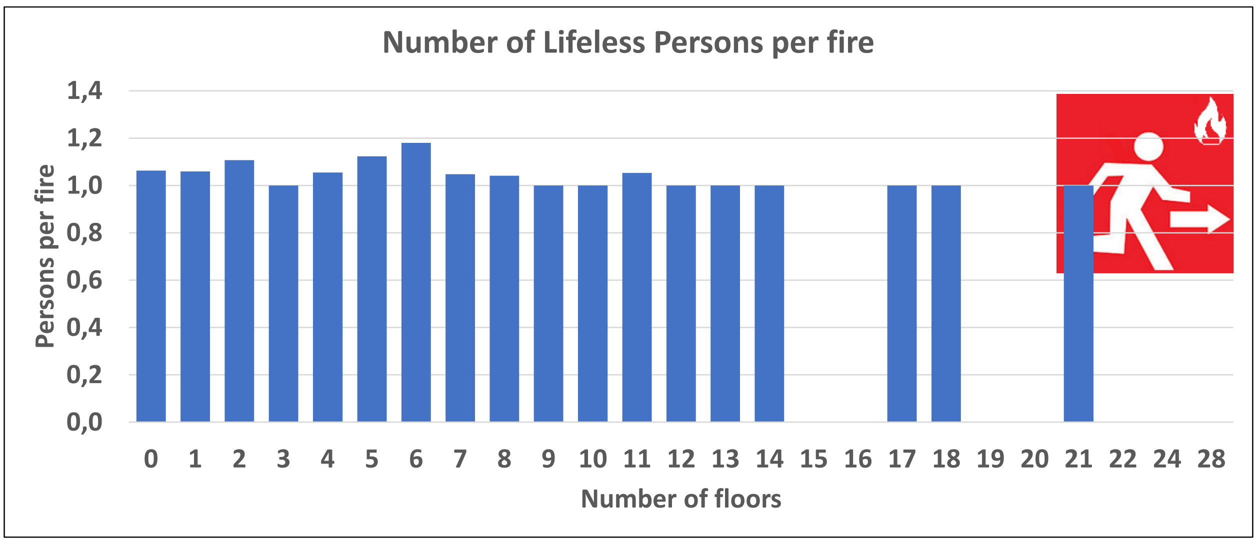

Figure 10.02.4-2: Number of " Lifeless Persons " per fire according to their respective number of floors.

Table 10.02.4-2 shows the distribution of lifeless persons by high-rise building type and floor spacing. The subdivision of the building floors is carried out as already applied in section 4. The result shows that 61% of the victims were registered in high-rise buildings with up to 10 floors. In another 36%, there were high-rise buildings with 11-20 floors. Regarding building type, residential high-rises stand out clearly with 86%.

Table 10.02.4-1: Distribution of the number of **lifeless persons** in high-rise fires by building type and number of floors.

Floors	Residential	Dormitory	∑	%
7	15	7	22	24.4
8	19	6	25	27.8
9	3	0	3	3.3
10	5	0	5	5.6
11	19	0	19	21.1
12	2	0	2	2.2
13	3	0	3	3.3
14	1	0	1	1.1
15	0	0	0	0.0
16	0	0	0	0.0
17	5	0	5	5.6
18	2	0	2	2.2
19	0	0	0	0.0
20	0	0	0	0.0
21	2	0	2	2.2
22	0	0	0	0.0
24	1	0	1	1.1
28	0	0	0	0.0
Sum	77	13	90	100
%	85.6	14.4	100	

Table 10.02.4-2: Distribution of the **Lifeless persons** by type of high-rise building and floor spacing.

Types of buildings	Number of Floors											
	≤10	11-20	21-30	31-50	>50	∑	≤10	11-20	21-30	31-50	>50	%
Residential	42	32	3	0	0	77	46.7	35.6	3.3	0.0	0.0	85.6
Dormitory	13	0	0	0	0	13	14.4	0.0	0.0	0.0	0.0	14.4
Sum	55	32	3	0	0	90	61.1	35.6	3.3	0.0	0.0	100

10.02.5 Summary

The case study of victims in high-rise buildings in Berlin (Germany) between 1997 and 2015 analyzed 5,471 fires with 18,117 fire victims.

Victims are classified into three categories:

- 9,436 "**Persons brought to safety**" (of which 2,585 are in high-rise buildings),
- 8,186 "**Smoke gas poisoned/injured persons**" (of which 1,639 in high-rise buildings), and
- 495 "**Lifeless Persons**" (90 of them in high-rise buildings).

Table 10.02.5-1 shows the link between the different categories of victims of high-rise fires. According to the report, 66.7% of the deaths (60 people found lifeless) were in fires in which neither injured persons nor persons to be brought to safety were registered. Thus, it can be said that most fire fatalities die alone. Another 14.4% of the deaths (13 people) were in fires in which one other person was registered as injured. That is followed by 3.3% of fire fatalities in fires (3 people), in which two more people were registered as wounded.

Table 10.02.5-1: Relative distribution of fire deaths in relation to the Smoke gas poisoned/injured persons per fire, and Persons brought to safety per fire.

Persons brought to safety per fire	Smoke gas poisoned/injured persons per fire								
	0	1	2	3	4	5	6	>6	%
0	66,7	14,4	3,3	0,0	2,2	1,1	1,1	0,0	88,9
1	1,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	1,1
2	0,0	0,0	0,0	1,1	0,0	0,0	0,0	0,0	1,1
3	0,0	1,1	0,0	0,0	0,0	0,0	0,0	0,0	1,1
4	1,1	0,0	1,1	0,0	0,0	0,0	0,0	0,0	2,2
5	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
6	0,0	1,1	0,0	0,0	0,0	0,0	0,0	0,0	1,1
7	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
8	0,0	0,0	0,0	0,0	0,0	0,0	1,1	0,0	1,1
9	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
10	1,1	0,0	0,0	2,2	0,0	0,0	0,0	0,0	3,3
>10	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
%	70,0	16,7	4,4	3,3	2,2	1,1	2,2	0,0	100,0

Only one unanswered question remains: how many fires with multiple fire victims were there?

From the point of view of the entire sample examined, the following can be said concerning "**lifeless persons**":

- In 5,005 cases (91.48%), no victim was found.
- In 432 cases (7.9%), one victim was documented.
- In 21 cases (0.38%), two victims per fire were identified.
- Then there was a fire with 7 and another fire with 8 "**lifeless people found**".

In the vast majority of all cases, one individual dies in fires (87.3%).

Table 10.02.5-2 to 10.02.5-5 presents the top 10 fires with the highest number of victims per category.

The Top 10 list of fires with the highest number of "***Persons brought to safety***" (P-Safe) covers 60 to 345 people rescued in each event. Four of the fires were extinguished in high-rise buildings.

Table 10.02.5-2: Top 10 list of fires with the highest number of "***Persons brought to safety***" (P-Safe).

Year	P-Safe	P-Smoke	P-Live	P-Vic	Fire object (Building)	Floors
2015	345	0	0	345	Administration, office	5
1997	200	0	0	200	Residential with trade and services	28
1999	200	13	0	213	Block of flats (detached)	12
2001	200	3	0	203	Residential with trade and services	5
2011	150	0	0	150	Administration, office	4
2003	130	0	0	130	Administration, office	8
2015	105	4	1	110	Residential with trade and services	5
1998	67	0	0	67	Unknown facility	0
2013	62	0	0	62	Residential	9
2010	60	0	0	60	Senior Citizens' Home	4

Table 10.02.5-3 illustrates the Top 10 list of fires with the highest number of "***Smoke gas poisoned/injured persons***" (P-Smoke). The interval of 17 to 28 people who were rescued in each individual event is shown. Two of the fires were extinguished in high-rise buildings.

Table 10.02.5-3: Top 10 list of fires with the highest number of "***Smoke gas poisoned/injured persons***" (P-Smoke).

Year	P-Safe	P-Smoke	P-Live	P-Vic	Fire object (Building)	Floors
2000	0	28	0	28	Transport facility (Metro station)	0
1997	19	25	0	44	Block of flats (detached)	3
2001	0	24	0	24	Sport facility	2
2005	36	24	0	60	Unknown facility	0
2009	36	20	0	56	Residential block	6
2011	18	20	3	41	Residential with trade and services	5
1997	6	19	0	25	Residential block	6
2000	38	18	0	56	Residential	10
2007	58	18	0	76	Block of flats (detached)	16
2002	5	17	0	22	Senior Citizens' Home	1

The Top 10 list of fires with the highest number of "***Lifeless people***" (P-Live) covers the interval of 2 to 8 people who died in each event. One of the fires was extinguished in high-rise buildings (Table 10.02.5-4).

Table 10.02.5-5 illustrates the Top 10 list of fires with the highest "***Total number of victims***" (P-Vic). The interval of 62 to 345 people who were rescued in each individual event is shown. Five of the fires were extinguished in high-rise buildings.

Table 10.02.5-4: Top 10 list of fires with the highest number of "***Lifeless people***" (P-Live).

Year	P-Safe	P-Smoke	P-Live	P-Vic	Fire object (Building)	Floors
2005	43	10	8	61	Residential block	5
1998	1	0	7	8	Residential block	6
2011	18	20	3	41	Residential with trade and services	5
1997	0	0	3	3	Residential with trade and services	4
2002	27	4	2	33	Residential	6
2000	0	3	2	5	Residential	0
2003	0	3	2	5	Block of flats (detached)	2
2005	10	3	2	15	Residential with trade and services	7
2000	0	2	2	4	Residential block	5
2005	0	2	2	4	Block of flats (detached)	5

Table 10.02.5-5: Top 10 list of fires with the highest number of "***Total victims***" (P-Vic).

Year	P-Safe	P-Smoke	P-Live	P-Vic	Fire object (Building)	Floors
2015	345	0	0	345	Administration building, office building	5
1999	200	13	0	213	Block of flats (detached)	12
2001	200	3	0	203	Residential building with trade and services	5
1997	200	0	0	200	Residential building with trade and services	28
2011	150	0	0	150	Administration, office building	4
2003	130	0	0	130	Administration, office building	8
2015	105	4	1	110	Residential with trade and services	5
2007	58	18	0	76	Block of flats (detached)	16
1998	67	0	0	67	Unknown facility	0
2013	62	0	0	62	Residential	9

11.0 CTIF Survey on High-Rise Buildings

A number of questions arise from considering sections 1 to 10. Answers to the questions were to be found in a survey among the CTIF member states.

In the beginning, it must be clarified what is meant by the term high-rise building at the national level (**Section 1**):

- Is there any special information about the number of high-rise buildings?
- At what height is a building defined as a high-rise?

In **Section 2**, a review of essential and interesting literature sources was given. The question that arises from this is:

- Are there any national publications on the subject of high-rise fires?

In **Sections 4 to 7**, overviews of high-rise buildings and their main types of use were given. The questions to the member states of CTIF are accordingly:

- Is it allowed to operate medical facilities in high-rise buildings?
- Is it allowed to operate facilities for disabled people in high-rise buildings?
- Is operating facilities in high-rise buildings, like kindergartens, schools, etc., allowed?
- Is it allowed to operate department stores and warehouses in high-rise buildings?
- Is operating mixed uses in high-rise buildings (residential, hotel, offices, business) permissible?

Regarding the fire situation in high-rise buildings, corresponding considerations were made in **Sections 8 and 9**. Now, the following questions are formulated:

- How many fires were recorded in high-rise buildings in 2023?
- How many fires in high-rise buildings were associated with the fire of the façade?

In **Sections 3 to 10**, various circumstances have been described which have an influence on firefighting in high-rise buildings:

- Do the fire brigades have specially trained teams for firefighting in high-rise buildings?
- Do the fire brigades use helicopters and drones for high-rise fires?
- Are there rules about the minimum number of stairwells and elevators in high-rise buildings?
- Are there rules on water supply for fire brigades in high-rise buildings?

Nineteen countries took part in the survey. We present the results of the study below.

Table 11.1-1: Is there any special information about the number of high-rise buildings?

Country	Yes	No	Remark
Austria	-	X	-
Belgium	-	X	-
Bulgaria	-	X	-
Croatia	-	X	No special information available.
Cyprus	X	-	Approximately 25.
Czech Republic	-	X	-
Denmark	-	X	-
Estonia	X	-	Approximately 1,179.
Hungary		X	-
Japan	-	X	-
Latvia	-	X	-
Lithuania	X	-	Approximately 593.
Luxembourg	-	X	-
New Zealand	X	-	Approximately 15,176.
Poland	X	-	Above 130.
Portugal	-	X	-
Romania	-	X	-
Singapore	-	X	-
Ukraine	-	X	No data

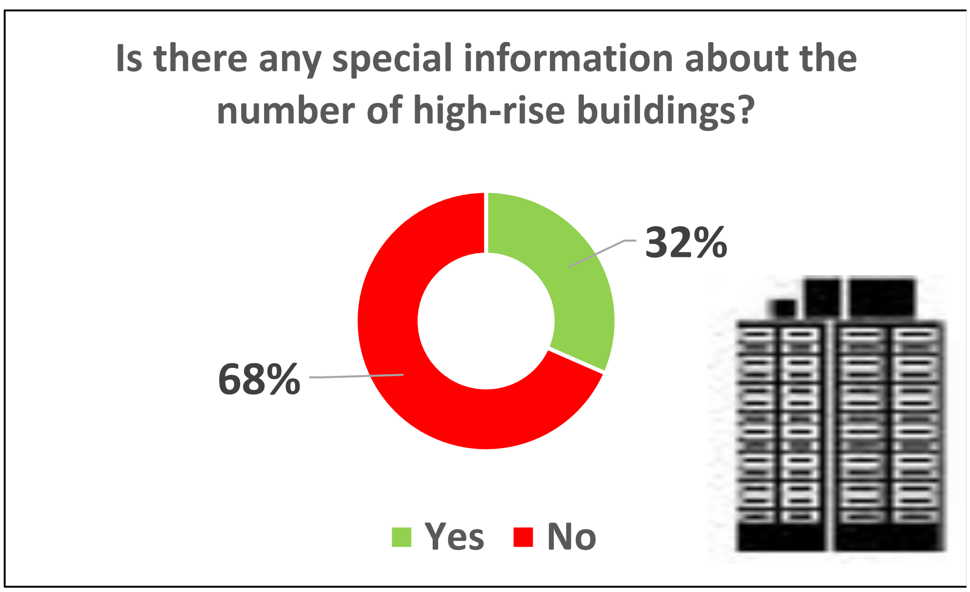

Figure 11.1-1: Is there any special information about the number of high-rise buildings?

68% of the participating states affirmed the existence of the information requested. The values given range from 25 to 15,176 high-rise buildings in the respective state. 32% of the answers were negative.

Table 11.1-2: At what height is a building defined as a high-rise?

Country	Yes	No	Remark
Austria	X	-	> 22 m (escape level).
Belgium	X	-	≥ 6 floors.
Bulgaria	X	-	≥ 25 m.
Croatia	X	-	> 22 m (according to fire protection regulations).
Cyprus	X	-	≥ 21 m
Czech Republic	X	-	≥ 22,5 m (Fire service), ≥ 45 m (Building regulations)
Denmark	-	-	No information
Estonia	X	-	≥ 28 m
Hungary	X	-	The building defined as high rise, when the top floor is above 30 meters.
Japan	X	-	≥ 28 m (Fire Service Act)
Latvia	X	-	≥ 10 floors (no official regulation)
Lithuania	X	-	≥ 26,5 m (≥ 10 floors)
Luxembourg	X	-	≥ 22 m (Floor level of the highest occupied room)
New Zealand	X	-	≥ 6 floors
Poland	X	-	Above 55 m above ground level or residential buildings with a height of more than 18 above-ground story's.
Portugal	-	X	No fire safety legislation, but buildings with ≥ 50 m height exist.
Romania	X	-	≥ 45 m
Singapore	X		More than 10-storey (>30m).
Ukraine	X	-	≥ 47 m

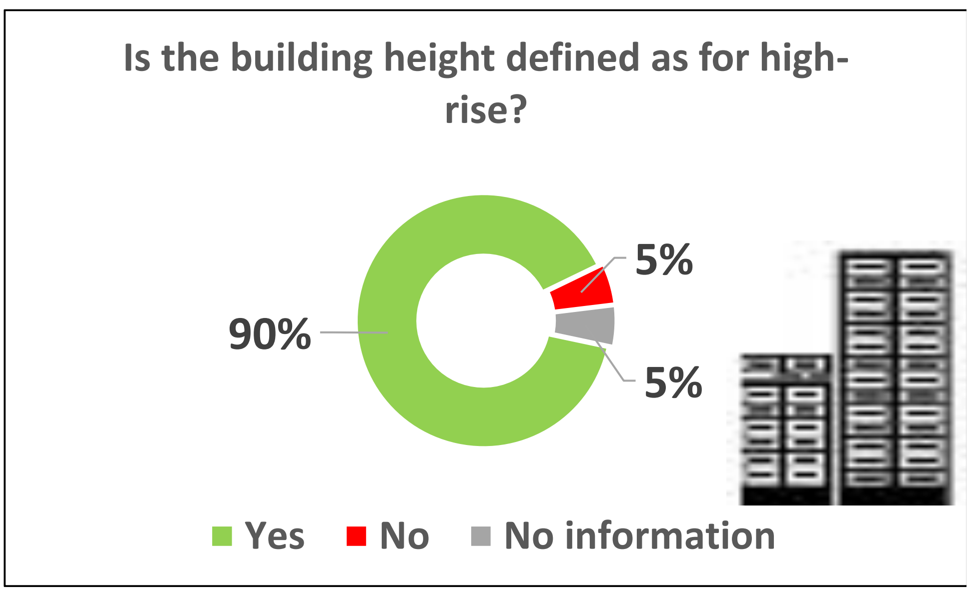

Figure 11.1-2: At what height is a building defined as a high-rise?

90% of the answers are yes; there are regulations regarding the minimum height of high-rise buildings. In the notes, the height is given from > 22 m to 55 m in the interval. In addition, for some countries, there is information regarding the number of floors: ≥ 6 to 10.

Table 11.1-3: How many fires were recorded in high-rise buildings in 2023?

Country	Yes	No	Remark
Austria	-	-	No statistics available.
Belgium	-	-	No statistics available.
Bulgaria	X	-	0 fire.
Croatia	-	-	No statistics available.
Cyprus	X	-	0 fire.
Czech Republic	X	-	342 fires.
Denmark	-	-	No statistics available.
Estonia	X	-	18 fires.
Hungary	X	-	243 fires.
Japan	-	-	No statistics available.
Latvia	-	-	No statistics available.
Lithuania	-	-	No statistics available.
Luxembourg	X	-	No statistics available.
New Zealand	X	-	51 fires.
Poland	X	-	43 fires
Portugal	-	-	No statistics available.
Romania	-	-	No statistics available.
Singapore	-	-	No statistics available.
Ukraine	X	-	87 in Ukraine (72 of them in Kyiv).

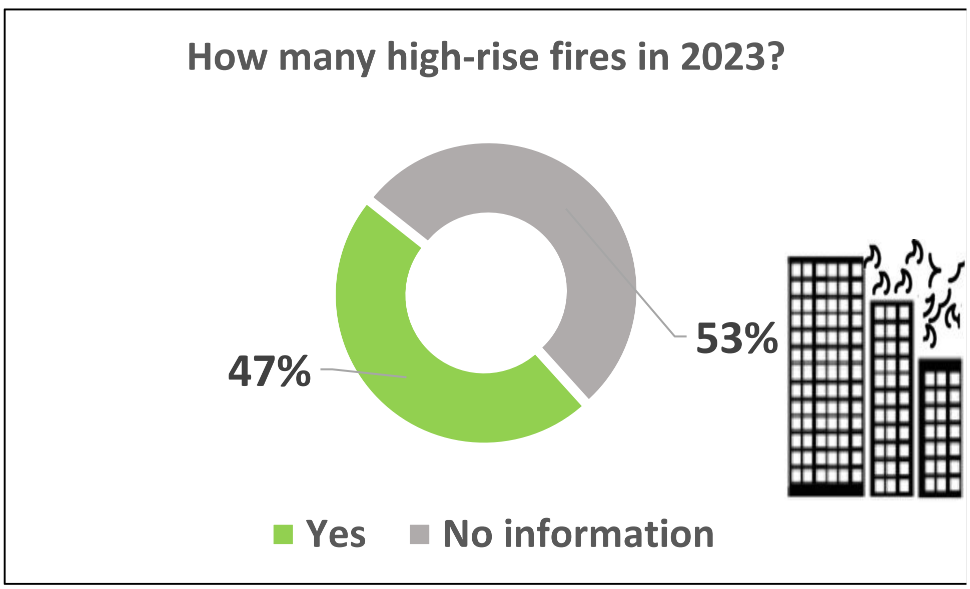

Figure 11.1-3: How many fires were recorded in high-rise buildings in 2023?

For 47% of all responses, it was confirmed that there were confirmed fires in high-rise buildings in 2023 (interval from 0 to 342 fires).

Table 11.1-4: How many fires in high-rise buildings were associated with the fire of the façade?

Country	Yes	No	Remark
Austria	-	-	No data available.
Belgium	-	-	No data available.
Bulgaria	-	-	No data available.
Croatia	-	-	No data available.
Cyprus	X	-	0 fires.
Czech Republic	-	-	No data available.
Denmark	-	-	No data available.
Estonia	X	-	0 fires.
Hungary	X	-	6 fires.
Japan	-	-	No data available.
Latvia	-	-	No data available.
Lithuania	-	-	No data available.
Luxembourg	-	-	No data available.
New Zealand	-	-	No data available.
Poland	X	-	0 fires.
Portugal	-	-	No data available.
Romania	-	-	No data available.
Singapore	-	-	No data available.
Ukraine	X	-	2 in Ukraine (1 fire of them in Kyiv).

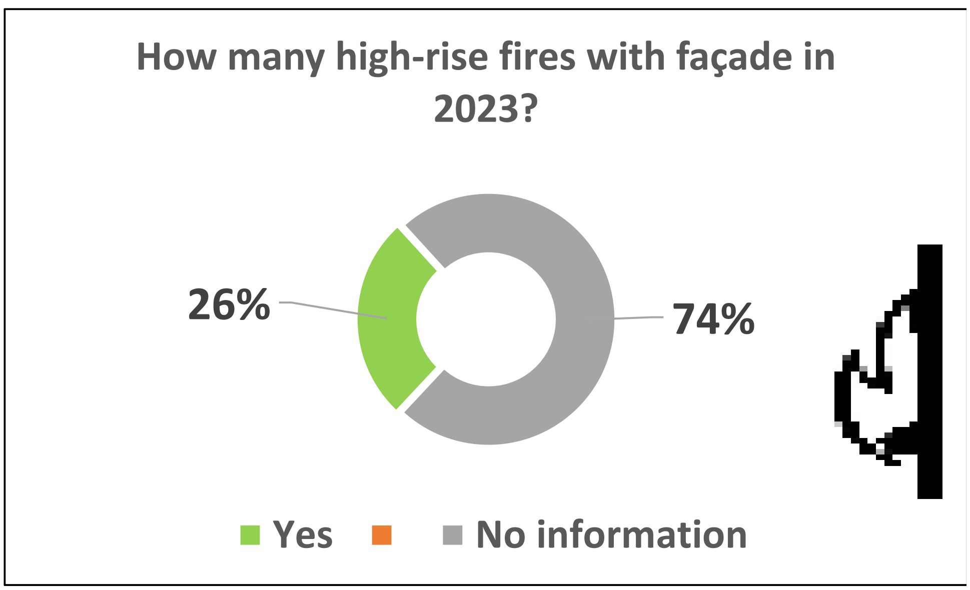

Figure 11.1-4: How many fires in high-rise buildings were associated with the fire of the façade?

When asked about the number of fires in high-rise buildings where the façade played a role, 26% answered yes; however, in most cases, there was no valuable feedback. As a result, the concrete case numbers are in the clear single-digit range.

Table 11.1-5: Are there any national publications on the subject of high-rise fires?

Country	Yes	No	Remark
Austria	-	X	No information available.
Belgium	-	X	No information available.
Bulgaria	-	X	-
Croatia	-	X	No information available.
Cyprus	-	X	-
Czech Republic	-	X	Public discussion on the given issue is ongoing.
Denmark	-	X	-
Estonia	-	X	-
Hungary	-	X	
Japan	X	-	-
Latvia	-	X	No information available.
Lithuania	X	-	-
Luxembourg	-	X	-
New Zealand	X	-	Internal Policy & Procedures, and Technical Guides.
Poland	-	X	-
Portugal	-	X	Only written safety legislation.
Romania	-	X	-
Singapore	-	X	-
Ukraine	-	X	-

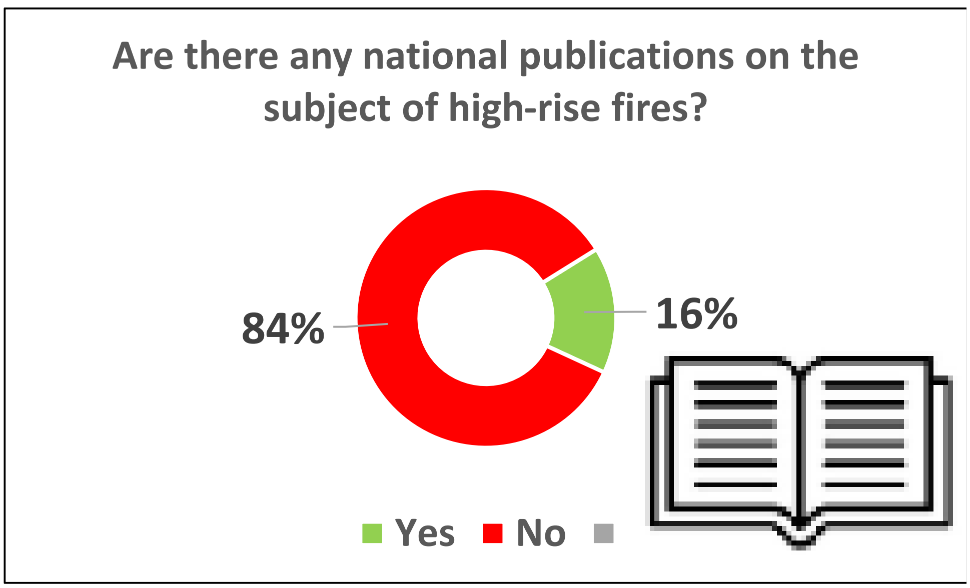

Figure 11.1-5: Are there any national publications on the subject of high-rise fires?

The question about existing national publications was answered negatively, at 84%. Only 16% of the responses reflect a positive response.

Table 11.1-6: Do the fire brigades have specially trained teams for firefighting in high-rise buildings?

Country	Yes	No	Remark
Austria	-	X	-
Belgium	X	-	Brussels, Antwerpen of Liège, and the Civil Protection Organization.
Bulgaria	X	-	All firefighters are trained for all types of fires, including high-rise fires.
Croatia	-	X	Special experience and action procedures of firefighters in parts of towns with high rise buildings are available.
Cyprus	-	X	There is no special team dedicated only for high-rise fires.
Czech Republic	-	X	All firefighters are trained for all types of fires, including high-rise fires, in territories where high-rise buildings are built.
Denmark	-	X	-
Estonia	-	X	All teams have the same training.
Hungary	-	X	The general training of firefighters includes extinguishing fires in high-rise buildings.
Japan	X	-	-
Latvia	-	X	-
Lithuania	-	X	-
Luxembourg	-	X	-
New Zealand	-	X	-
Poland	X	-	All teams are trained. There are some teams with additional equipment dedicated for high rise buildings fires (especially during building time).
Portugal	-	X	-
Romania	-	X	-
Singapore	X	-	-
Ukraine	-	X	-

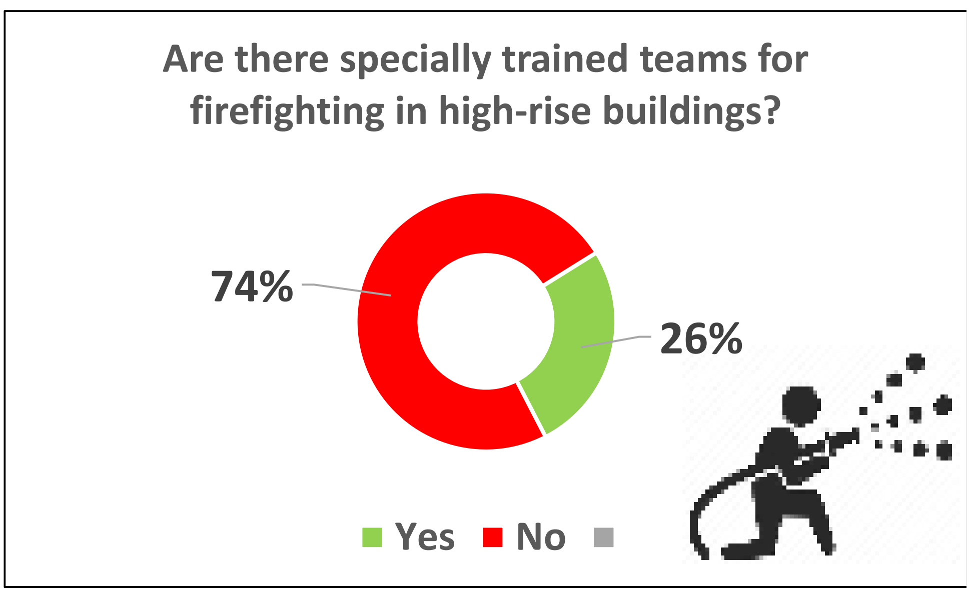

Figure 11.1-6: Do the fire brigades have specially trained teams for firefighting in high-rise buildings?

The question of special training for firefighters provided a clear answer: 74%—no and 26%—yes. In most cases, the topic of high-rise buildings is part of general fire brigade training.

Table 11.1-7: Do the fire brigades use helicopters for high-rise fires?

Country	Yes	No	Remark
Austria	-	X	-
Hungary	-	X	-
Croatia	-	X	-
Belgium	-	X	-
Bulgaria	-	X	-
Cyprus	-	X	-
Czech Republic	X	-	-
Denmark	-	X	-
Estonia	-	X	For situational awareness only.
Japan	X	-	-
Latvia	-	X	-
Lithuania	-	X	-
Luxembourg	-	X	-
New Zealand	-	X	-
Poland	X	-	Fire Service can if the need arises.
Portugal	-	X	-
Singapore	-	X	-
Romania	-	X	-
Ukraine	-	X	-

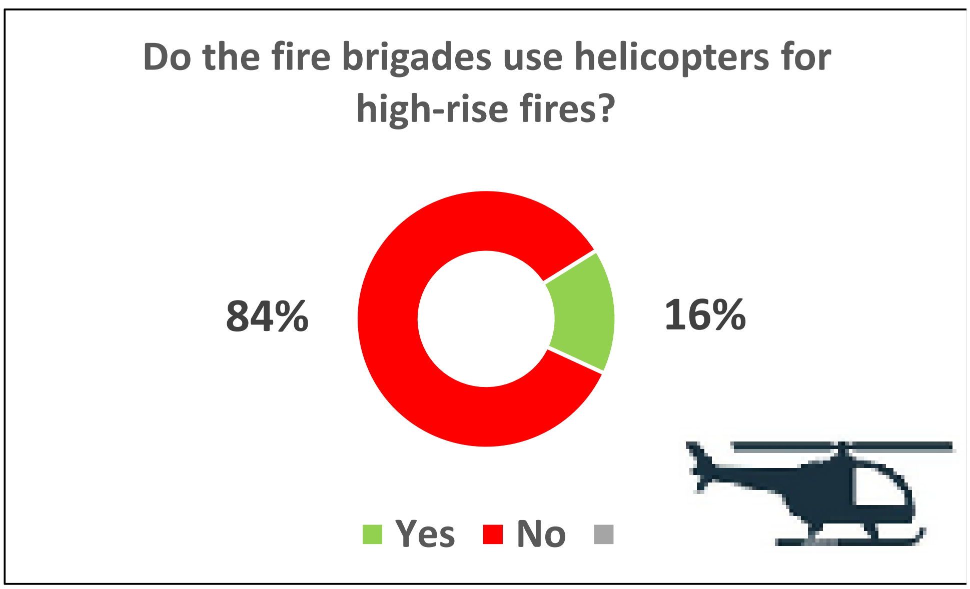

Figure 11.1-7: Do the fire brigades use helicopters for high-rise fires?

Helicopters are generally only used in 16% of the participating countries.

Table 11.1-8: Do the fire brigades use drones in high-rise fires?

Country	Yes	No	Remark
Austria	-	X	Assessment only.
Belgium	-	-	In Brussels, Antwerpen of Liège only.
Bulgaria	-	X	-
Croatia	-	X	Very rare, for surveillance.
Cyprus	X	-	-
Czech Republic	X	-	-
Denmark	X	-	-
Estonia	-	X	For situational awareness only.
Hungary	-	X	Each county has a drone unit. Use planned from the next year, for the emergency assessment of the building and the situation.
Japan	-	-	No information available.
Latvia	-	X	-
Lithuania	-	X	For situational awareness only.
Luxembourg	-	X	-
New Zealand	X	-	-
Poland	X	-	-
Portugal	X	-	-
Romania	-	X	-
Singapore	-	X	-
Ukraine	-	X	-

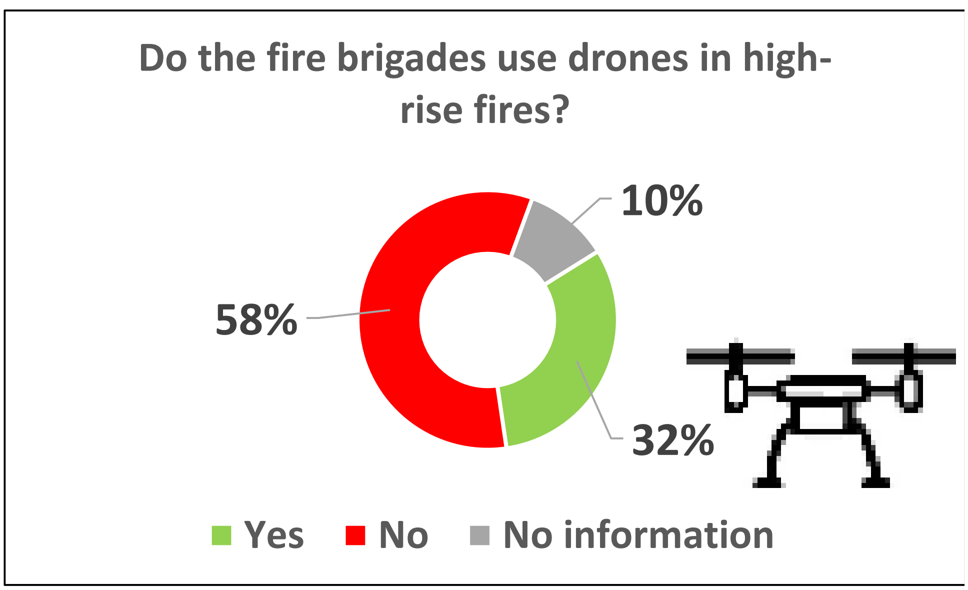

Figure 11.1-8: Do the fire brigades use drones in high-rise fires?

In high-rise fires, drones are used in 32% of cases; however, they are not used in 58% of cases.

Table 11.1-9: Is it allowed to operate medical facilities in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	-
Hungary	X	-	-
Croatia	-	X	No medical facilities existing in high rise buildings in the country.
Belgium	-	-	No information available.
Bulgaria	X	-	Special requirements exist.
Cyprus	-	X	-
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	-	X	-
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	Special requirements exist.
Luxembourg	X	-	-
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	Special requirements exist.
Romania	-	-	No legislation regulating this aspect.
Singapore	-	-	No information available.
Ukraine	X	X	Special requirements exist.

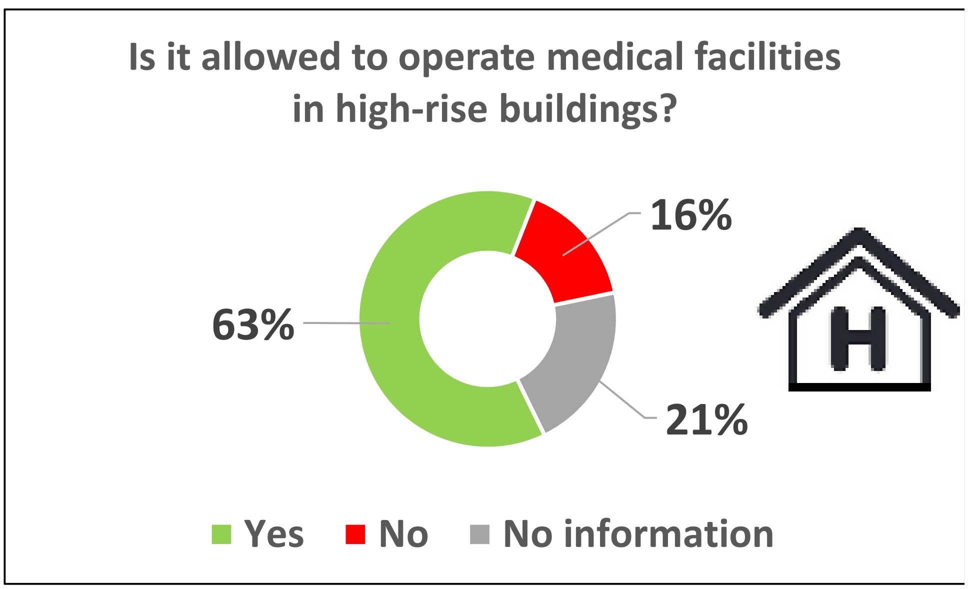

Figure 11.1-9: Is it allowed to operate medical facilities in high-rise buildings?

63% of the country allows the operation of medical facilities in high-rise buildings. All other countries answered the question in the negative, or there is a lack of evaluable data.

Table 11.1-10: Is it allowed to operate facilities for disabled people in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	-
Belgium	-	-	No information available.
Hungary	-	X	-
Croatia	-	X	No disabled people (as elderly homes) suited in high rise buildings in the country.
Bulgaria	X	-	Special requirements exist.
Cyprus	-	X	-
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	-	X	-
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	-
Luxembourg	X	-	-
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	Special requirements exist.
Romania	-	-	No legislation regulating this aspect.
Singapore	-	-	No information available.
Ukraine	X	-	Special requirements exist.

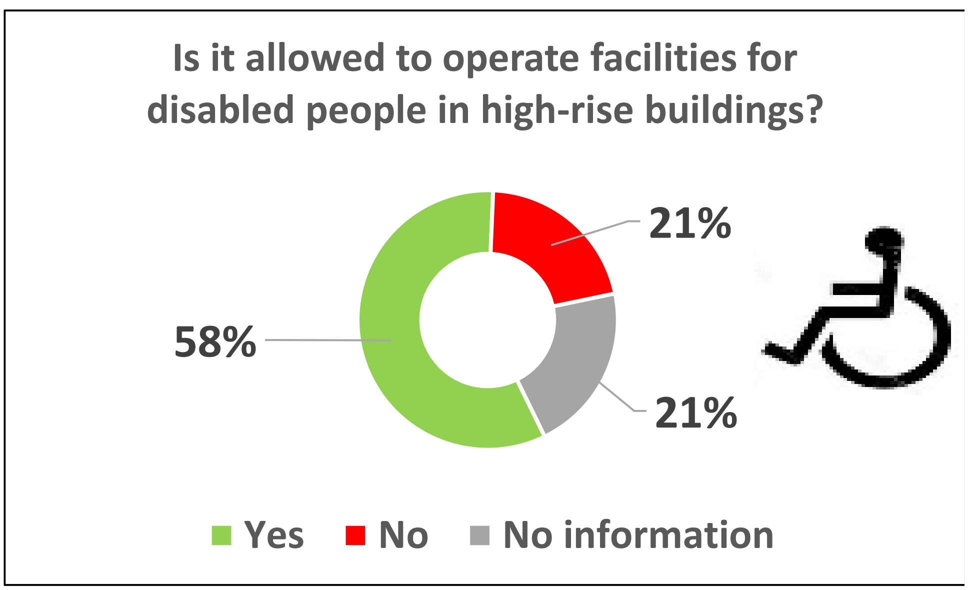

Figure 11.1-10: Is it allowed to operate facilities for disabled people in high-rise buildings?

58% of the countries surveyed state that facilities for disabled people may be used in high-rise buildings. However, in 21%, this is prohibited.

Table 11.1-11: Is it allowed to operate facilities like kindergarten, schools etc. in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	-
Belgium	-	-	No information available.
Hungary	X		-
Croatia	-	X	No special regulation, but usually kindergartens, schools etc. have special separate buildings
Bulgaria	X	-	Special requirements exist.
Cyprus	-	X	-
Czech Republic	-	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	-	X	Special requirements exist.
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	Special requirements exist.
Luxembourg	X	X	Special requirements exist.
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	Special requirements exist.
Romania	-	-	There is no legislation regulating this aspect.
Singapore	-	-	No information available.
Ukraine	X	-	Special requirements exist.

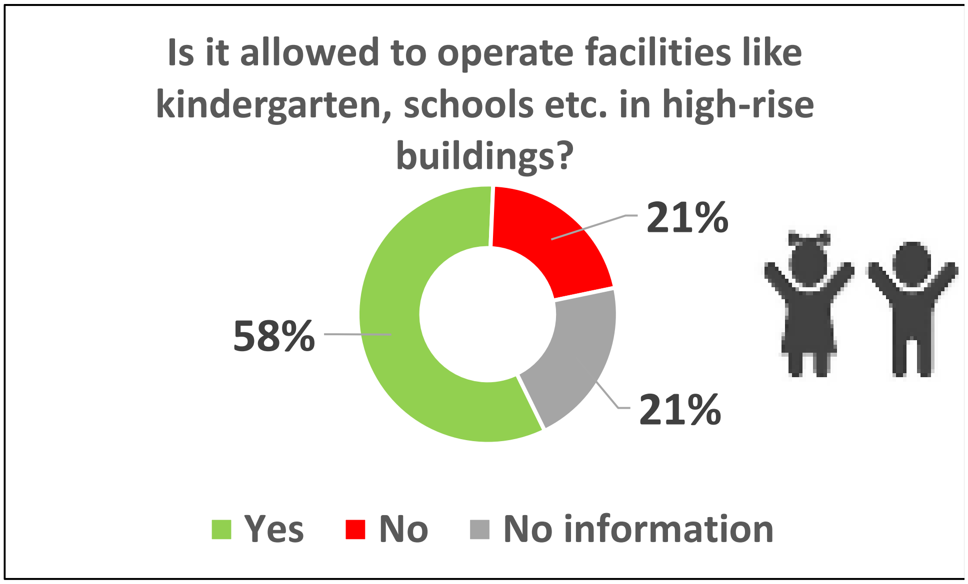

Figure 11.1-11: Is it allowed to operate facilities like kindergarten, schools etc. in high-rise buildings?

In 58% of countries, it is allowed to operate facilities like kindergartens, schools, etc., in high-rise buildings. However, for a further 21%, this is prohibited.

Table 11.1-12: Is it allowed to operate department store and warehouses in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	-
Belgium	-	-	No information available.
Hungary	X	X	Department stores allowed; warehouses not allowed.
Croatia	-	X	No such facilities existing in high rise buildings in the country.
Bulgaria	-	-	For department stores no regulations exist, warehouses may be not permitted.
Cyprus	X	-	Special requirements exist.
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	-	X	-
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	-	X	-
Luxembourg	X	-	-
New Zealand	X	-	Special requirements exist.
Poland	X	-	In high-rise buildings, only fire compartment (production and storage) with a cell load density of up to 200 MJ/m^2 may occur.
Portugal	X	-	Special requirements exist.
Romania	-	-	There is no legislation regulating this aspect.
Singapore	-	-	No information available.
Ukraine	X	-	Special requirements exist.

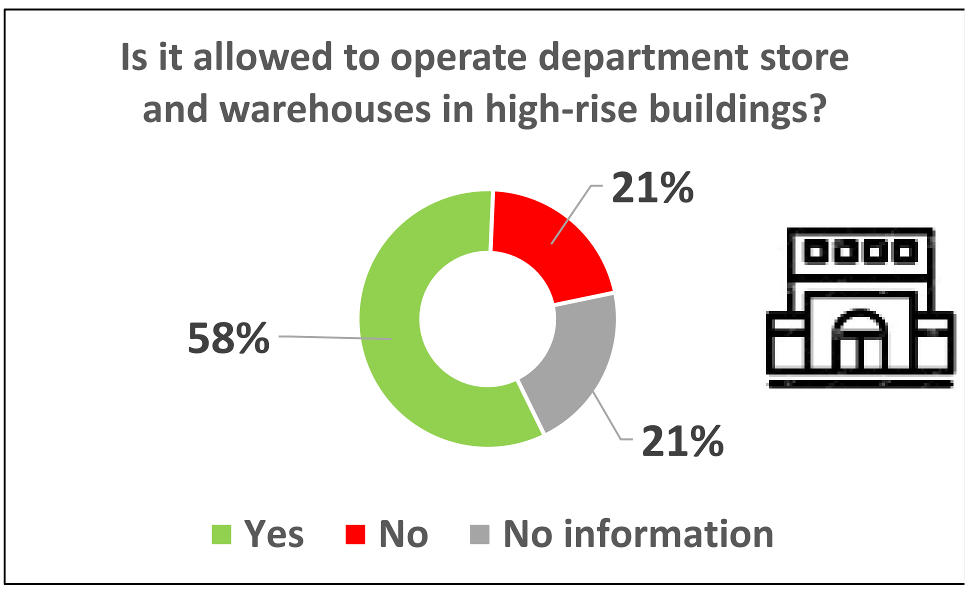

Figure 11.1-12: Is it allowed to operate department stores and warehouses in high-rise buildings?

In 58% of countries, it is allowed to operate department stores and warehouses in high-rise buildings. However, in 21%, this is prohibited.

Table 11.1-13: Is it permissible to operate mixed uses in high-rise buildings (residential, hotel, offices, business)?

Country	Yes	No	Remark
Austria	X	-	-
Hungary	X	-	-
Croatia	X	-	-
Belgium	-	-	No information available.
Bulgaria	X	-	-
Cyprus	X	-	-
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	X	-	Special requirements exist.
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	-
Luxembourg	X	-	-
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	-
Romania	-	-	There is no legislation regulating this aspect.
Singapore	X	-	-
Ukraine	X	-	Special requirements exist.

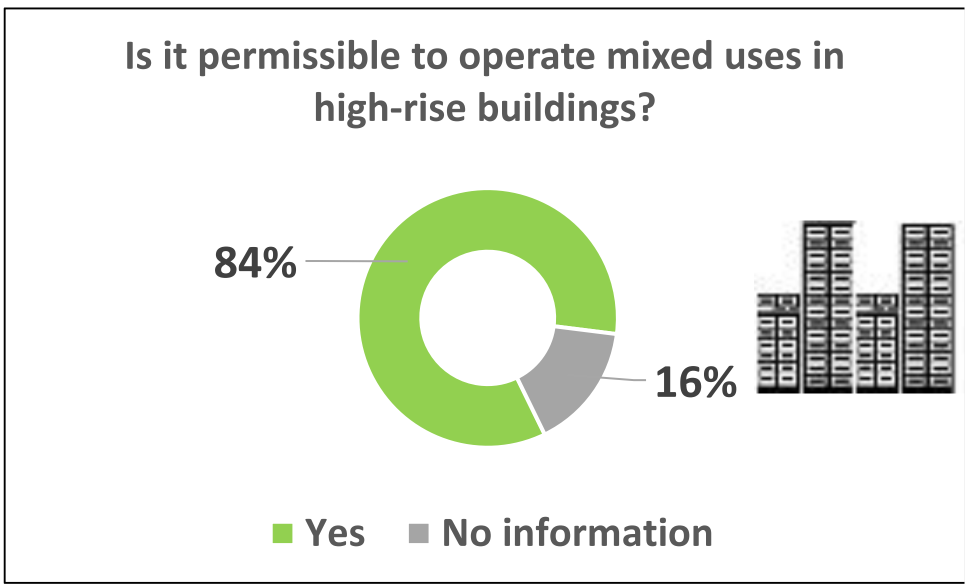

Figure 11.1-13: Is it permissible to operate mixed uses in high-rise buildings (residential, hotel, offices, business)?

In 84% of countries, mixed-use (residential, hotel, offices, business) uses are allowed in high-rise buildings. However, in 16%, no information is available.

Table 11.1-14: Are there rules about the minimum number of stairwells in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	Special requirements exist.
Belgium	-	-	No information available.
Hungary	X	-	-
Croatia	X	-	According to international norms, and according to building rules.
Bulgaria	X	-	Special requirements exist.
Cyprus	X	-	Special requirements exist.
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	X	-	Special requirements exist.
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	Special requirements exist.
Luxembourg	X	-	Special requirements exist.
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	Special requirements exist.
Romania	-	-	There is no legislation regulating this aspect.
Singapore	X	-	-
Ukraine	X	-	Special requirements exist.

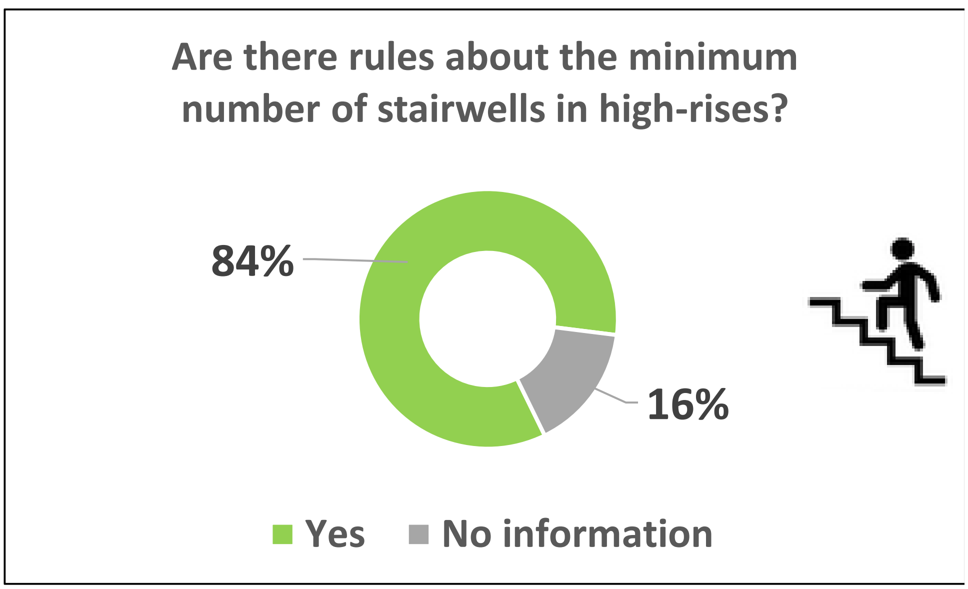

Figure 11.1-14: Are there rules about the minimum number of stairwells in high-rise buildings?

In most countries, the number of stairwells in high-rise buildings is considered to be of great importance (84%). However, 16% of the information is missing.

Table 11.1-15: Are there rules about the minimum number of elevators in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	Special requirements exist.
Hungary	X	-	-
Croatia	X	-	According to international norms, and according to building rules.
Belgium	-	-	No information available.
Bulgaria	X	-	Special requirements exist.
Cyprus	X	-	Special requirements exist.
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	X	-	Special requirements exist.
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	-	X	Special requirements exist.
Luxembourg	-	X	Special requirements exist.
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	Special requirements exist.
Romania	-	-	There is no legislation regulating this aspect.
Singapore	X	-	-
Ukraine	X	-	Special requirements exist.

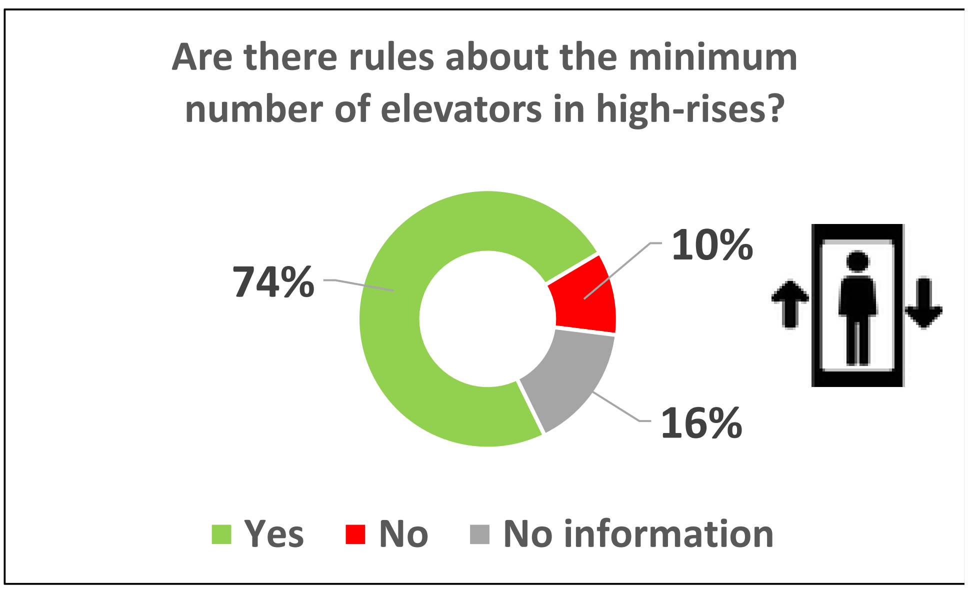

Figure 11.1-15: Are there rules about the minimum number of elevators in high-rise buildings?

In most countries, the number of stairwells in high-rise buildings is considered to be of great importance (74%). However, in a further 10%, no regulation exists.

Table 11.1-16: Are there rules on water supply for fire brigades in high-rise buildings?

Country	Yes	No	Remark
Austria	X	-	Special requirements exist.
Hungary	X	-	-
Croatia	X	-	According to fire-protection measures.
Belgium	-	-	No information available.
Bulgaria	X	-	Special requirements exist.
Cyprus	X	-	Special requirements exist.
Czech Republic	X	-	Special requirements exist.
Denmark	-	-	No information available.
Estonia	X	-	Special requirements exist.
Japan	X	-	-
Latvia	X	-	Special requirements exist.
Lithuania	X	-	Special requirements exist.
Luxembourg	X	-	-
New Zealand	X	-	Special requirements exist.
Poland	X	-	-
Portugal	X	-	-
Romania	-	-	There is no legislation regulating this aspect.
Singapore	X	-	Wet riser.
Ukraine	X	-	Special requirements exist.

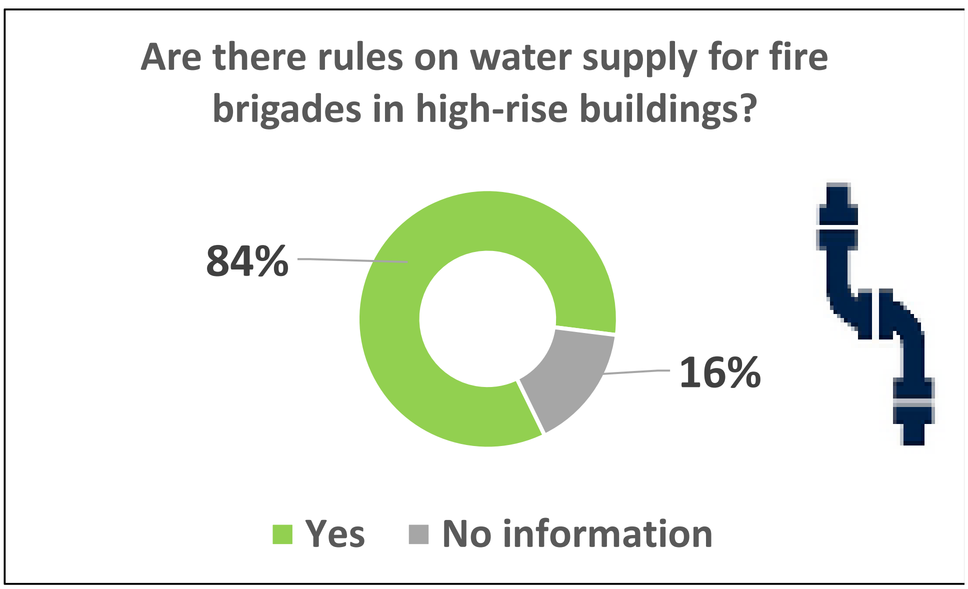

Figure 11.1-16: Are there rules on water supply for fire brigades in high-rise buildings?

In most countries, rules on water supply for fire brigades in high-rise buildings are essential (84%). However, 16% of the information is missing.

Some remarks and thoughts on fire statistics in India

In recent years, CTIF's Centre for Fire Statistics has been trying to obtain transparent data on the fire situation in India. Indian readers mostly rejected the information in our previous reports: The number of fires shown is far too high. What to do? In the following, we make another attempt to shed more light on the darkness of Indian fire statistics. As always, reviews are welcome!

With an area of 3,287,263 km^2, India is one of the largest countries in the world in terms of area. With about 1.426 billion inhabitants, India has been the most populous country in the world since April 2023. India is made up of 28 states and eight federal areas. Its capital is New Delhi. Fire protection is organized at the level of the states, some union territories (UT), and municipalities (M); Table 1.

Table 1: Fire Services in India. [1]

No.	State / UT/ M	Fire Service (establishment)
1	Andhra Pradesh	Andhra Pradesh State Disaster Response & Fire Services Department (1942)
2	Arunachal Pradesh	Arunachal Pradesh Fire & Emergency Service
3	Assam	Assam Fire & Emergency Services (1956)
4	Bihar	Bihar Fire Service (1946)
5	Dadar and Nagar Haveli	Fire and Emergency Services (1984)
6	Delhi	Delhi Fire Service (1946)
7	Goa	Goa Fire & Emergency Services (1984)
8	Haryana	Urban Local Bodies
9	Himachal Pradesh	Himachal Fire & Emergency Services (1972)
10	Jammu And Kashmir	Fire & Emergency Services (1893)
11	Jharkhand	Jharkhand Fire Services
12	Karnataka	Karnataka Fire & Emergency Services (1942)
13	Kerala	Kerala Fire & Rescue Services (1956)
14	Maharashtra	Maharashtra Fire Services (1957)
15	Manipur	Manipur Fire Service, former Bombay Fire Brigade, (1987)
16	Meghalaya	Meghalaya Fire & Emergency Service (1972)
17	Mizoram	Mizoram Fire & Emergency Service (1972)
18	Nagaland	Nagaland Fire & Emergency Service (1963)
19	Odisha	Odisha Fire & Service (1942)
20	Puducherry	Puducherry Fire and Emergency Services
21	Punjab	Punjab Fire Services
22	Sikkim	Sikkim Fire & Emergency Service (1977)
23	Tamil Nadu	Tamil Nadu Fire & Rescue Services (1908)
24	Telangana	Telanagana State Disaster Response & Fire Services (2014)
25	Tripura	Tripura Fire & Service (1957)
26	Uttar Pradesh	Uttar Pradesh Fire Service (1944)
27	Uttarakhand	Uttarakhand Fire & Emergency Services (2000)
28	West Bengal	West Bengal Fire & Emergency Services, former Calcutta Fire Brigade, (1822)

How can one imagine the situation of the fire services in India?

[1] https://www.firepedia.in/

The Directorate General Fire Services, Civil Defense and Home Guards (Ministry of Home Affairs Government of India) is responsible for all fire services in India. [1]

The question of the creation of nationally uniform Indian fire statistics is a lengthy and complicated process. The source "Compilation of Minutes of the Meetings of the Standing Fire Advisory Committee/Council from 1st Meeting to 38th Meeting" describes the situation from 1956 to 2017 in great detail. [2] An expert report (RMSI Report) on the fire protection situation in India was published in 2012. [3]

The following overview can be obtained from the source. [4] [5]

Table 2: Main parameter of Fire Services in India.

Data as on 31.12.2018	Available	Requirement as per RMSI Report, 2012	Total gap
Fire Stations	3,377	8,559	5,191
Manpower	54,239	557,123	503,365
Operational Firefighting Appliances, Vehicles	7,306	32,710	25,460

To collect statistical data, the RMSI report used the following data matrix:

“Monthly number of fire calls and other special service calls …”

- Month-Year
- Total Calls (A+B+C+D)
- Total Fire Incidence calls (A)
- Occupancy wise break up of fire incidence (if any)
  - Residential
  - Industrial
  - Institutional/commercial
  - Others
- Total Rescue incidence (B)
- Break up of Rescue incidence (if any)
  - Road Accidents
  - Building collapse
  - Animal
  - Others
- Special service calls (C)
- False/malicious calls (D)
- Total injured
- Total Death.

In the RMSI reports, all pages for statistical analyses are marked "intentionally left blank" about information on the statistics. All results were classified as "confidential," which deprived the Indian public of crucial information. As a result, the expertise reflects more or less of the data, as shown in Table 2. These are then combined with cost statements. Unfortunately, the statistical data basis on which all this was calculated is still unknown.

Therefore, we state: A national database on fires is not known. Figures are published at the state level. The National Crime Records Bureau (NCRB) released the Accidental Deaths & Suicides in Annual India Reports for many years. The NCRB is an Indian government agency responsible for collecting and analyzing crime data, as defined by the Indian Penal Code (IPC) and Special and Local Laws (SLL). NCRB is headquartered in New Delhi and is part of the Ministry of Home Affairs (MHA). [2]

Accidental deaths have been divided into two broad categories, i.e., "deaths from natural forces" and "deaths from other causes." The classification of types and causes of accidental deaths is carried out exclusively for statistical purposes. Causes that can be traced back to "forces of nature" are the deaths caused by "forest fires," "hurricanes," "landslides," "tornadoes," "floods," "avalanches," "cold effects," "earthquakes," "heat/sunstroke," "lightning," and "torrential rain" and many more.

The deaths due to other causes are "plane crashes," "suffocation," "stampedes," "drowning," "sudden deaths," "poisoning," "electric shocks," "traffic accidents," "factory/machinery accidents," "drug overdose," "collapse of a building," "accidental explosions," "accidental fire," "firearms," "mine or quarry disaster," "deaths due to the consumption of illegal/toxic beverages," "falls," "deaths of women during pregnancy" and "killings by animals."

We would like to point out that "forest fires" and "accidental fires" are in different categories.

About the number of fires, we initially relied on a press release titled "*Every 5th fire death in the world is in India: Study.*" [1] We quote from it as follows: "*... India recorded 1.6 million fires and 27,027 deaths, according to a 195-nation analysis by Global Diseases Burden published in The BMJ Injury Prevention journal recently. The Indian deaths were 2.5 times the figures in China, where 10,836 people died in fires in 2017*." For this source, we will use the abbreviation BMJ in the following.

This creates the following situation: in the source BMJ quoted, there are 1.6 million fires with 27,000 fire deaths on the one hand, while the NCRB gives 13,397 fires with 13,159 fire deaths; all figures for 2017.

Why do the numbers differ so much?

About the definition of "fire fatality/death," a comparatively simple answer must be given. In the source BMJ, the cases are defined as " ***deaths by fire, heat, hot substances, and burns***." [1] This means that many accidents that are not fires but, for example, scalds caused by hot water, etc., are considered in this definition. The NCRB, on the other hand, only takes into account pure "***accidental fires***" (without forest fires), but only those ***fires in which at least one victim was to be mourned***! [3]

In Table 3, we have summarized selected data from the NCRB statistics. It is essential to look at the table columns "Average" and "Deaths per fire." In the "Average" column, it is noticeable that the respective number of fires is more or less identical to the number of deaths. The conclusion could be: At least one person dies in every fire in India. To put it another way, there are no fires without fire victims. Consequently, the values in the column "Deaths per 100 fires" are between 77 and 125 (numbers greater than 100 – there were fires with two or more deaths; numbers less than 100 – there were fires without deaths but with injured people, but this will not be considered further here).

Table 3: Cases for "accidental fire" (F) and killed people (deaths, D) according to NCRB for selected units.

No.	State / UT	Population, in 1,000,000	Fires (F)		Deaths (D)		Average 2019-2020		Deaths per x-fire	
			2019	2020	2019	2020	F	D	1F	100F
1	Andhra Pradesh	49.6	317	230	321	227	274	274	1,0	100
2	Delhi NCR	46.1	89	128	150	102	109	126	1,2	116

[2] https://www.ncrb.gov.in/.

[3] https://1pdf.in/ncrb-report/.

No.	State / UT	Population, in 1,000,000	Fires (F)		Deaths (D)		Average 2019-2020		Deaths per x-fire	
			2019	2020	2019	2020	F	D	1F	100F
3	Mizoram	1.5	2	1	2	1	2	2	1,0	100
4	Nagaland	2.2	4	0	5	0	2	3	1,3	125
5	Tamil Nadu	76.9	714	743	719	745	729	732	1,0	100
6	Telangana	37.7	211	226	211	124	219	168	0,8	77
7	Uttarakhand	12.2	19	26	19	27	23	23	1,0	102
8	Subtotal	226.2	1,356	1,354	1,427	1,226	1,355	1,327	1,0	98
9	India	1,402.618	11,037	9,329	10,915	9,190	10,183	10,053	1,0	99

Is this assumption valid?

A press release lists the major fire events under the title “Chronology of major fire tragedies occurred in India-(1995-2012).” [4] We have supplemented this list with events from other sources. [5] [6]

- 1944 April 1944: In the Maharashtra State, the Bombay Port Fire was recorded with 66 firefighters and approx. more than 1000 citizens were killed.
- 1975: Mine explosion kills 431 in Chasnala.
- 1979 July 29: Major fire incident at Lakshimki Talkies cinema in Tuticorin of Tamil Nadu (73 deaths, injured 88).
- 1981 June 12: In Gujarat, the Nilkanth Mahadev temple fire claims 49 deaths.
- 1981 February 8: In Karnataka, a Circus Fire in Bangalore claims 66 deaths.
- 1984: Union Carbide plant fire kills 3,800 in Bhopal.
- 1985 February 23: The Rajnandgaon train fire occurred in Madhya Pradesh (50 deaths)
- 1989 February 2: 42 persons died in the Premier Studio Fire, Mysore (Karnataka).
- 1990 April 16: The train fire in Patna (Bihar) claims 70 deaths.
- 1990 October 10: A train fire in Cherpalli (Andhra Pradesh) caused the death of 40 passengers.
- 1991: 29 Shantytown hut fires kill 15, New Delhi.
- 1995 December 23: A school incident in Mandi Dabwali, Haryana, turned into a major tragedy when a fire broke out in an educational building holding its annual function. Only one exit was available. 446 deceased and nearly 200 people who suffered injuries had to be lamented.
- 1997 February 23: The Baripada Religious Congregation in Odisha: Fire kills 190 worshipers.
- 1997 June 7: In Tamil Nadu, the Brihadeeswarar temple fire killed 48.
- 1997 June 13: Fifty-nine people died, and 103 were injured in an inferno at Uphar cinema hall in New Delhi. The transformer at the parking level burst and 20 cars in the parking lot caught fire, eventually leading to a large-scale fire in the five-story building that housed the cinema hall and several offices.
- 2001 August 6: Mentally ill patients (28) were charred to death when a fire broke out at a private mental asylum in Erwadi in Tamil Nadu. Bodies fettered in chains were all that remained after the fire broke out. These chains were tied to the feet of the mentally ill to stop them from escaping the asylum.
- 2002 June 26: The Shree Lee International footwear factory in Agra (Uttar Pradesh) caught fire and killed 42.
- 2002 February 27: A train fire near Godhara (Gujarat) claimed the lives of 58 passengers.

[4] https://www.dnaindia.com/india/report-chronology-of-major-fire-tragedies-in-india-1705068.
[5] https://www.firepedia.in/major-fire-incidents.
[6] https://www.beyondcarlton.org/worst-fire-accidents-india-2019/.

- 2003 May 16: The Ladhowal rail disaster, was a flash fire which began on the Frontier Mail train service in India, and engulfed three carriages before it could be extinguished. 39 people lost their lives and another 15 were hospitalised with severe burns.
- 2004 January 23: The Srirangam wedding tragedy in the Padmapriya Marriage Hall (Tamil Nadu) cost many lives (54 dead, 40 injured). The only exit to the marriage hall was a narrow staircase. Subsequent to the tragedy, fire safety measures were made compulsory in marriage and community halls, with periodic inspections by fire service personnel and the local administration. Dozens were trapped under the blazing thatched `pandal' that crashed. The fire and smoke and the consequent scramble blocked the only available one exit routes.
- 2004 July 16: A fire in the Saraswathi primary school in Kumbakonam (Tamil Nadau) killed 91 children. Thatched roofs of the school caught fire.
- 2005 July 27: A major fire struck ONGC's Mumbai High North offshore complex, located approximately some 100 km off Mumbai (Maharashtra). The accident was the consequence of a collision between a support vessel and the production platform. The fire caused 22 fatalities (of whom 11 recovered and 11 missing).
- 2005 September 15: 35 people were killed and 50 injured in a fire in three illegal firecracker factories in Khusropur village of Bihar.
- 2006 February 22: Ten people were killed and 19 injured in a fire at a fireworks plant in Tamil Nadu.
- 2006 April 10: 64 people died and 80 sustained injuries after a fire engulfed the tent at a crowded consumer trade fair in Meerut. The blaze, sparked off by an electrical short-circuit in one of the enclosures, took minutes to spread across to the two other adjoining enclosures that were razed before any help could arrive. Hundreds were trapped because of inadequate openings in the air-conditioned tented enclosures.
- 2006 November 22: 10-12 died and 18 injured in the Leather factory 24 Pargana fire in the Greater Kolkata Area (West Bengal).
- 2007 August 14: At least 17 people were killed after a fire wrecked an Indian military ammunition dump in Kashmir. The blaze that sent artillery shell and mortars exploding into the air and raining down on surrounding villages also injured more than two dozen people.
- 2007 November 1: A massive fire at an oil depot in western India killed 11 people.
- 2009 October29: In Jaipur (Rajasthan) a major fire in the IOC Oil Depot claims the live of 12 and injured more than 300.
- 2010 February 23: The Carlton Tower fire, Bangalore (Karnataka) burns (9 deaths).
- 2010 March 29: The Stephen Court fire was a major fire in a historical building, that occurred in Kolkata (West Bengal). The fire started by a short circuit in the lifts, rapidly engulfing the fifth and sixth floors. 43 people died in the fire and 20 injured.
- 2011 December 9: A fire swept through the AMRI hospital in Kolkata (West Bengal), killing 73 people, majority of them patients, and sending emergency workers scrambling to evacuate survivors from the smoke-filled building.
- 2011 November 20: Fire broke out at a community function of the eunuchs, gathered at the community center in Nandnagari in East Delhi. 14 eunuchs died and 50 injured.
- 2012 June 21: A major fire broke out in Mantralaya - the seat of Maharashtra government. None victims reported.
- 2012 July 30: The Nellore train fire occurred, when the Chennai-bound Tamil Nadu Express train caught fire near Nellore, Andhra Pradesh. At least 32 passengers died and 27 were injured. The fire gutted the sleeper coach in 20 minutes.
- 2012 May 23: Major fire in Punjab National Bank at New Delhi's Parliament Street by short circuit. None victims reported.

- 2012 August 27: The Chala LPG tanker disaster was a road transport accident on Indian National Highway 17 at Chala in the Kannur District of Kerala State. An Indian Oil Corporation LPG road tanker hit a road lane divider, overturned, and exploded, starting several building fires. The accident killed 20 and injured 21 people.
- 2012 September 5: In Tamil Nadu, the Om Sakthi Firework Factory went up in flames (40 deaths, 70 injuries).
- 2013 February 27: The Kolkata market fire was a fire accident in a five-storied marketplace in Kolkata, the capital city of West Bengal. An estimated 19 people, who were mostly laborers working in the market, were killed in the accident. More than 17 people were injured. Initial reports indicate a short circuit might have initiated the fire on the market's first floor.
- 2013 December 28: An Andhra Pradesh train fire caused the death of 26.
- 2014 June 27: A massive fire broke out following a blast in the Gas Authority of India Limited's underground gas pipeline at Nagaram in the East Godavari district of Andhra Pradesh. The accident claimed 23 lives and 38 injured people.
- 2014 July 18: Lotus Business Park was covered with smoke after a fire broke out on its 21st floor and spread between the 20th and 22nd floor, leading to loss of life and property at Andheri West in Mumbai. One fireman died in the multi-story building.
- 2016 April 11: In the State of Kerala, the Puttingal Devi Temple in Kollam burned and caused the death of 108 worshipers.
- 2017 November 1: A boiler explosion occurred at the Feroze Gandhi Unchahar Thermal Power Station, operated by government-owned National Thermal Power Corporation (NTPC) Limited, in Unchahar (Uttar Pradesh), killing 38 people and injuring 100 others.
- 2017 December 29: The Kamala Mills fire killed 14 people and injured 55 at two rooftop restaurants in Mumbai.
- 2019 February 12: A massive fire on the fifth floor of the Arpit Palace Hotel, Karol Bhag, New Delhi. It was the late hours of the night when the fire broke out because of a short circuit, which resulted in the entire floor being on fire. The adjacent floor, too, eventually caught fire. Families were heading out for marriage the very next morning. Many people had to jump off the building for the sake of their lives. There were about 17 people who died in this accident, and many more were injured. The cause of the fire was clear to be a short circuit. But what lay beneath all the fire was that many regulatory policies were not followed. The area was far beyond what they had been granted, and the fire extinguishers were out of gas.
- 2019 May 9: Five people were killed in a cloth godown fire in Pune. A massive fire broke out in the godown where Rajyog wholesale saree center employee Urli Devachi worked. The cause of the fire is unknown. The fire broke out in the wee hours; the employees were asleep. They could not escape the fire as the godown was locked from outside.
- 2019 May 24: A fire occurred at a commercial complex in the Sarthana Jakatnaka area of Surat in the Gujarat state of India. Twenty-two students died, and 19 others were injured in an academic coaching center located on the building's terrace. A short circuit started the fire on the ground floor; the destruction of a wooden staircase trapped the students in the coaching center.
- 2019 August 13: 13 workers charred to death in a chemical explosion in Mumbai. A fire triggered by a leaking chemical barrel led to massive explosions in a chemical unit in Sirpur, Mumbai. The blast happened when at least 100 employees were in place. The fire chemical leakage was triggered, and serial blasts from the nitrogen cylinders were generated due to the fire.2019 December 8: As many as 43 people were killed in a gruesome fire accident in Delhi. The fire was reportedly started in a 4-storey illegal factory unit in Anaj Mandi, Delhi. At least 50 laborers were reported to be sleeping in the cramped space. The illegal factory unit had no

license to operate a factory and moreover there were no fire safety equipment. There were only two exits from the building of which one was blocked by stacking of materials. As there was a very small exit route, most of the laborers were trapped inside the burning building.

- 2019 December 23: Nine lives perished in a cloth godown fire accident in Delhi. Delhiites woke up to another horrendous fire accident in a cloth godown in the Kirari area. The glaring violations, such as no fire safety equipment, poor access, and only one staircase, make one wonder how these godowns were allowed to operate.
- 2020 June 3: An explosion occurred at the Yashashvi Rasayan Pvt. Ltd. chemical factory at Dahej (Gujarat). Five people were killed, and 57 were injured in the blast.
- 2020 August 9: A major fire broke out in the early morning hours at a COVID-19 facility at the Hotel Swarna Palace in Vijayawada, in Andhra Pradesh. The fire blaze killed 11 people and wounded a further 22. The hotel was used as a temporary COVID-19 facility.
- 2020 August 20: A major fire broke out late at night in an underground hydroelectric power plant in Srisailam in Telangana. The fire blaze killed nine people, including five engineers and 15 employees who were inside the power plant and escaped since the fire broke out.
- 2020 November 4: A blast at a chemical factory in Ahmedabad (Gujarat) caused the deaths of 12 people and injuries to nine others.
- 2021 April 23: A fire in a hospital in the coastal city of Virar, in Maharashtra, killed at least 13 COVID-19 patients.
- 2021 May 1: A fire in a hospital in Bharuch, Gujarat, killed at least 16 COVID-19 patients and two nurses.
- 2021 June 7: A fire in Pune (Maharashtra) killed at least 18 people. The fire broke out at a chemical plant on the outskirts of Pune. The plant manufactured chemicals and sanitizers. When the fire occurred, 37 workers were trapped inside the building.
- 2022 May 13: A fire began on the first floor of a four-story office and commercial building in the Mundka area of Delhi. It killed 27 people and injured 40 others, and at least 50 people were rescued. The fire is believed to have been started by a short circuit.
- 2022 June 4: A major explosion and fire occurred at a chemical plant in Hapur (Uttar Pradesh). At least 13 people were killed and 20 others injured.
- 2022 October 2: A fire occurred at a Durga Puja pandal, a temporary structure for worship, in Narthuwa village in Bhadohi district of the State of Uttar Pradesh. Seventeen people died, and at least 75 were injured in the incident. The investigation revealed that the decorative fiber polythene sheets had caught fire due to heat caused by halogen lights.
- 2023 February 27: A massive fire broke out in Kohima (Nagaland), causing complete damage to Mao Market and NN Market, one of the biggest commercial areas in Kohima. No casualties were reported. Over 200 shops were gutted, and the fire is suspected to have been caused by an electrical short circuit.
- 2023 August 27: The Duttapukur blast exploded at a firecracker factory at Mochpol village under Duttapukur police station near Barasat (West Bengal). The factory was on the second floor of a two-story building, where the explosion and a major fire occurred. The blast killed nine people and injured 12 others.
- 2024 February 6: A fire at a fireworks factory in Harda, Madhya Pradesh, killed 11 people and injured 150 others.
- 2024 May 25: A fire broke out at a gaming zone in Rajkot, Gujarat, killing 33 people (3 injured persons). The amusement park was built in 2024 with tin roofs and two floors in temporary structures. According to reports, the buildings had insufficient fire extinguishers and emergency exits. The building also did not possess the required certification from the fire department.

- 2024 May 24: A fire at a hospital in New Delhi killed seven people and injured five.
- 2024 August 21: An explosion at an Escientia Advanced Sciences pharmaceutical manufacturing facility in the Atchutapuram Special Economic Zone in the Anakapalli neighborhood of Visakhapatnam (Andhra Pradesh) killed at least 18 people. Fifty more were injured.
- 2024 October 28: Four people were killed in a firecracker accident at the Theru Anjootambalam Veererkavu temple in Nileshwaram.
- 2024 November 15: A fire broke out in the Neonatal Intensive Care Unit of Maharani Laxmi Bai Medical College in Jhansi, Uttar Pradesh, resulting in the deaths of at least 18 newborns and injuring 16 others, most of which later succumbed to injuries. The incident occurred as the hospital treated an overcrowded ward with 55 infants, far exceeding its capacity of 18 beds.
- 2025 May 18: At least 17 people, including six children aged under 5 years, died when a fire broke out due to a short circuit in a building in the city of Hyderabad.
- 2025 April 2025: At least 14 people, including two children, have been killed after a massive fire broke out at Rituraj Hotel in Kolkata city (West Bengal).

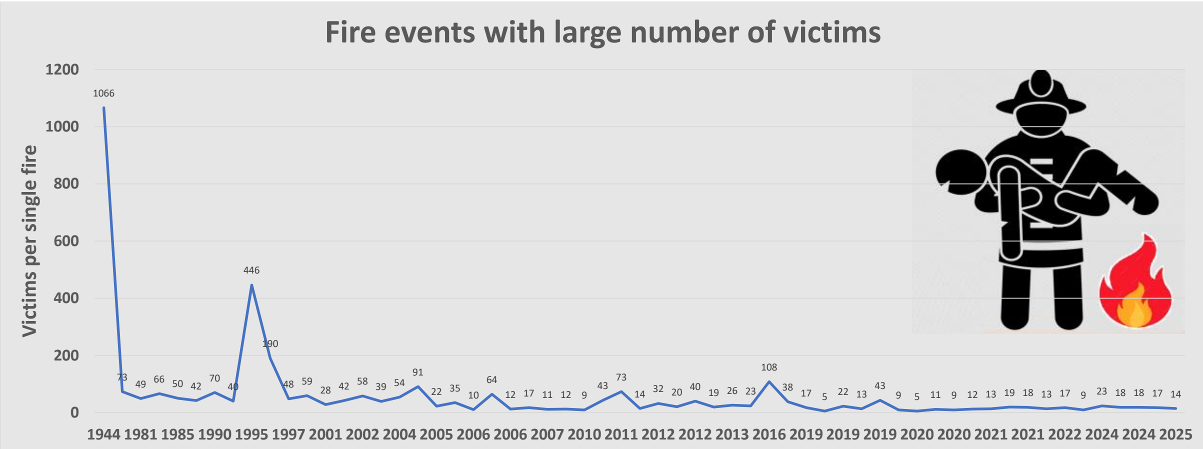

Figure 1: Fire events in India with large number of deaths.

From the journalists' point of view, the overview takes into account fires with and without, sometimes very many, victims (Figure 1).

Here is a timeline of major fire tragedies in Delhi: [7] [8]

- 1997 June 13: A fire broke out at the Uphaar theatre during the screening of the Bollywood Film 'Border,' killing 59 people and injuring over 100."
- 1999 May 31: 57 killed and 27 injured when fire broke out in a chemical market in Lal Kuan.
- 2011 November 20: Fourteen people died, and over 30 were injured when a fire broke out at a community function of eunuchs in Nandnagari in east Delhi.
- 2018 January 20: 17 killed, including 10 women, when a fire broke out in a firecracker factory in Bawana, outer Delhi.
- 2018 April 13: Four members of a family, including two minor children, were killed in a significant fire in Delhi's Kohat Enclave.
- 2018 April 23: At least 300 shanties were gutted after a major fire broke out in Shahdara's MS Park. A girl was killed in the fire.

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[7] https://www.timesnownews.com/mirror-now/mundka-fire-tragedy-a-timeline-of-major-fire-tragedies-in-delhi-article-91550227.

[8] https://www.hindustantimes.com/india-news/a-look-back-at-major-fire-accidents-in-delhi-ncr/story-4VAoPUDw5GIQdStvoDf6lI.html.

- 2018 January 20: At least 10 women and seven men were charred to death in a fire that broke out in a firecracker unit in northwest Delhi's Bawana industrial area.
- 2018 May 29: A massive blaze, which fire officials said was of "highest magnitude", broke out at a godown in south Delhi's Malviya Nagar. No casualty was reported.
- 2018 November 19: Four people were killed and one person was injured after a fire broke out at a factory in central Delhi's Karol Bagh.
- 2019 February 12: 17 killed and 35 injured when a fire broke out in a four-story hotel in Karol Bagh.
- 2019 December 8: 45 dead and 50 injured after a fire broke out in a paper factory in Anaj Mandi at Rani Jhansi Road.
- 2019 February 7: Scores of patients and staff at Noida's Metro Hospital and Heart Institute had to be evacuated after a major fire.
- 2019 January 30: Four people were injured in a fire at a chemical factory in Okhla Phase-I in southeastern Delhi.
- 2022 13 May: a fire began on the first floor of four-story office and commercial building in the Mundka area of Delhi. It killed 27 people and injured 40 others, and at least 50 people were rescued. The fire is believed to have been started by a short circuit.

Let's look at the 2017 press release using Mumbai as an example: [9]

- December 29: 14 persons killed and 55 injured in a major blaze in a rooftop pub that engulfed the Kamala Mills Compound in Lower Parel.
- December 18: 12 laborers killed and 10 hurt when a fire broke out in a 'dry snacks and farsan` wholesale shop in Sakinaka, Andheri East.
- October 6: A major blaze erupted in a BPCL diesel tank following a lightning strike as the city and surroundings were lashed by torrential rain and thunderstorm. Though there were no human casualties, an undisclosed quantity of diesel worth crores of rupees burnt out for nearly three days before the fire was extinguished.
- January 23: Six minor children, aged between six and 13, sustained burns in a fire that broke out in a slum pocket in the LCC Compound, adjacent to the Masjid Bunder station. Though all the children later survived despite their burns, the Central Railway was compelled to halt all operations for nearly an hour as power supply was switched off to prevent the spread of the blaze or damage to railway assets.

The overview contains notable fires, both with and without victims.

Analogous lists of other Indian states could be added. The result is very likely to be similar: In Indian reality, there are fire events without victims and fires with some and sometimes very high numbers of victims.

Now, all that remains to be considered is the number of fires in India and how these fires can be divided according to their extent.

Since official fire statistics of the federal states are not available or only sparsely available, we will try to reconstruct the situation using two examples. Let's first look at Delhi NCR (Table 4) and then Mumbai (Table 5). For both examples, we quote from Indian press releases (see the tables in the column "Remark / Source"). Table 4 lists the key statements extracted from the respective media D1-D13. It is striking that annual values are not always given, but usually a number of months were chosen as the

[9] https://zeenews.india.com/mumbai/kamala-mills-fire-a-timeline-of-major-fire-tragedies-that-hit-mumbai-in-2017-2070742.html.

reporting period, which does not make it easy to compare the statements. There is also no stringent uniformity in the terms used: fires (F), fire operations/fire calls - F(calls). Nevertheless, the total number of fire brigade operations in Delhi NCR can also be filtered out:

- D13: Total calls (means fire and other/special calls) are given for the years 2022 to 2024 at well over 30,000 each. The number of annual fires should then logically be correspondingly smaller.
- D6: Total calls (means fire and other/special calls) count 32,000 in average (D8: 22,000 calls as annual average).

For the "fire calls", F (calls), i.e. presumably the real fires plus false alarms for fires, it can be said:

- D1: Fires, F (calls) average 13,500 for 2015-2016.
- D2: Fires, F (calls) average 15,500 for 2019-2020.
- D3: Fires, F (calls) are around 16,500 for 2022 (15,600 in 2023, D7 and D8).

The number of real fires is then the following information:

- D5: number of fires (F) are 17,000 (2019-2020), 15,000 (2020-2021), 14,000 (2021-2022) and 16,500 (2022).
- D9: fires – 14,000-16,000 in 2021/2022/2023.

Table 4: Fire situation in Delhi National Capital Region (NCR) in recent years, a media review (F – fires, D – deaths, I – injured persons).

No.	Parameter	Year(s)	Number	Remark / Source
D1	F (calls)	2015-2016	27,089	Kanika Bhatia and Aakash Upadhyay: Assessing the Risk of Fire Hazard: A case study of Delhi, March 2023, Conference: 5th World Congress on Disaster Management, New Delhi, Volume II, https://www.researchgate.net/publication/369538674.
D2	F (calls) D D	2019-2020 2015-2016 2020-2021	31,157 339 346	Kanika Bhatia and Aakash Upadhyay: Assessing the Risk of Fire Hazard: A case study of Delhi, March 2023, Conference: 5th World Congress on Disaster Management, New Delhi, Volume II, https://www.researchgate.net/publication/369538674.
D3	F D I	2022 2022 2022	16,518 82 722	https://www.newdelhitimes.com/delhi-fire-services-releases-data-for-fire-related-incidents-in-2022-delhi/. Times of India, Jan.15, 2023. https://timesofindia.indiatimes.com/city/delhi/more-than-16500-fire-related-incidents-claimed-82-lives.
D4	F	2023, Jan.-Mar.	6,969	Times of India, Apr. 5, 2023, https://timesofindia.indiatimes.com/city/delhi/playing-with-fire-a-stark-increase-in-fatalities-in-first
D5	F F F F D D I I D	2019-2020 2020-2021 2021-2022 2022 2019-2020 2021-2022 2019-2020 2022 2022	17,231 15,158 14,268 16,518 100 55 843 392 82	https://www.financialexpress.com/india-news/more-than-16500-fire-related-incidents-claimed-82-lives-in-2022-delhi-fire-service/2948835/.

No.	Parameter	Year(s)	Number	Remark / Source
	I	2022	722	
D6	F D I Total calls	2023, Jan.-Nov. 2023, Jan.-Nov. 2023, Jan.-Nov. Annual average	14,393 56 600 32,000	https://thepatriot.in/delhi-ncr/over-14k-fire-related-incidents-claimed-56-lives-in-delhi-this-year-43287. https://www.newdelhitimes.com/over-14000-fire-incidents-in-delhi-between-january-to-november-2023-delhi-fire-services/.
D7	F D Rescued eople	2023 2023 2023	15,610 50 689	https://www.thehindu.com/news/cities/Delhi/over-50-casualties-seen-in-blazes-in-capital-in-2023-delhi-fire-service/article67696662.ece.
D8	F D Stations Staff Total calls	2023 2023 2023 2023 Annual average	15,610 59 61 3,616 22,000	https://www.newdelhitimes.com/59-persons-died-in-fire-incidents-in-delhi-in-2023-delhi-fire-services/. According to the data, 12 people died in fire incidents in January, two in February, 14 in March, three in April, May and June, four in July, one in August, three in September and October, eight in November and three in December. Personnel: 3280 firefighters, 289 mechanics, rescue calls only: average 5000-70000.
D9	F F F D D D Injured, saved Injured, saved Injured, saved	2021 2022 2023 2021 2022 2023 2021 2022 2023	14,999 16,158 15,610 56 82 59 396 722 589	https://www.hindustantimes.com/cities/delhi-news/five-deaths-every-month-due-to-fire-in-delhi-in-2023-data-101704220043493.html.
D10	F F	2024, May 2023, May	956 2,280	https://thepatriot.in/delhi-ncr/delhi-sees-over-138-spike-in-fire-cases-in-may-2024-as-to-last-year-vivek-vihar-hospital-baby-care-east-49715.
D11	F F	2024, Jan. 1-May 26. 2023, Jan. 1-May 26.	8,912 6,436	https://www.news18.com/india/fire-incidents-break-ten-year-record-in-delhi-with-over-8000-calls-between-jan-and-may-2024-8909564.html.
D12	D D I F F	2024, Jan.-Jun. 2023, Jan.-Jun. 2024, Jan.-Jun. 2024, Jan.-Jun. 2023, Jan.-Jun.	83 39 390 12,687 7,774	https://thepatriot.in/delhi-ncr/delhi-83-killed-over-390-injured-in-fire-in-first-six-months-of-2024-official-data-says-51833. According to the data by the Delhi Fire Services, 16 people were killed in fire in January, another 16 in February, 12 in March, four in April, seven in May and 24 till June 24. Fire-related injuries were recorded as follows: 51 in January, 42 in February, 62 in March, 78 in April, 84 in May, and 77 up to June 24. In recent incidents, on June 25, four family members were killed in a fire in Dwarka. In May, seven newborns died in a massive fire at Baby Care New Born Hospital in east Delhi's Vivek Vihar, which spread to adjacent buildings. The same day, three people died in a fire in a four-story residential building in Krishna Nagar, east Delhi.
D13	Total calls Total calls Total calls	2024, as of Dec.18 2023, as of Dec.18 2022, as of Dec.18	35,331 31,399 31,031	https://thepatriot.in/cover-story/delhi-fire-services-recorded-11-more-distress-calls-this-year-63015.

Table 5: Fire situation in Mumbai in recent years, a media review (F – fires, D – deaths, I – injured persons).

No.	Parameter	Year(s)	Number	Remark / Source
M1	F (calls) F (calls) D I D	2008-2020 2020 2020 2020 2008-2020	57,540 3,841 33 99 680	https://timesofindia.indiatimes.com/city/mumbai/short-circuit-is-cause-of-most-fires-shows-data/articleshow/89066561.cms Deaths: 247 men, 248 women, 29 children.
M2	F (calls) F (calls) F (calls) F (calls) F (calls) F (calls)	2020-2024 2017 2018 2019 2020 2021	22,764 4,454 4,959 5,324 4,512 3,515	https://www.hindustantimes.com/cities/mumbai-news/22k-fire-calls-reported-in-mumbai-in-5-years-data-101643045295046.html.
M3	D F (calls) I F (calls) D I F (calls) D I	2023, Jan.-Dec. 5 2023, Jan.-Dec. 5 2023, Jan.-Dec. 5 2022 2022 2022 2021 2021 2021	33 4,721 290 4,417 13 160 4,065 19 173	https://timesofindia.indiatimes.com/city/mumbai/154-jump-in-fire-accident-fatalities-in-city-this-year/articleshow/105766750.cms.
M4	D Fire stations Mini-stations F (calls) I D	2023 2023 2023 2023, Jan.-Dec. 5 2023, Jan.-Dec. 5 2023, Jan.-Dec. 5	33 35 19 4,721 290 33	https://indianexpress.com/article/cities/mumbai/mumbai-fire-brigade-mfb-data-on-fire-incident-mumbai-fire-stations-9064048/.
M5	F (calls) D I F (calls) D I F (calls) D I	2023 2023 2023 2022 2022 2022 2021 2021 2021	5,074 33 300 4,417 13 160 4,065 19 173	https://timesofindia.indiatimes.com/city/mumbai/33-killed-300-injured-in-2023-mumbai-fires-stricter-fire-safety-rules-urged/articleshow/106528982.cms.
M6	F (calls) D I	2021-2023 2021-2023 2021-2023	13,000 65 473	https://www.thehindu.com/news/cities/mumbai/65-deaths-occurred-in-13000-fire-incidents-in-mumbai-in-last-3-years/article68362726.ece.
M7	F (calls) D I	2021-2023 2021-2023 2021-2023	13,000 65 473	https://www.timesnownews.com/mumbai/65-deaths-occurred-in-13000-fire-incidents-in-mumbai-in-last-3-years-cm-shinde-article-111437807.
M8	F (calls) F (calls) F (stop fires) F (stop fires)	2023 2024 2024 2023	5,074 5,301 5,228 4,993	https://www.mumbailive.com/en/civic/mumbai-logs-5301-fire-incidents-in-2024-227-more-than-last-year-88019. "Stop fire calls" are minor fires that are extinguished before the fire department arrives.
M9	F (calls) F (calls) F (stop fires) F (stop fires)	2024 2023 2023 2024	5,301 5,074 4,993 5,228	https://www.freepressjournal.in/mumbai/mumbai-records-5301-fire-incidents-in-2024-227-more-than-previous-year. Note: Stop' fire calls: the blazes which were extinguished either before fire brigade arrived or were doused before declaring Level 1.

No.	Parameter	Year(s)	Number	Remark / Source
M10	F (calls) D F (high-rise) F (residential) F (commercial) F (slums) F (short circuit) F (gas cylinders)	2008-2018 2008-2018 2008-2018 2008-2018 2008-2018 2008-2018 2008-2018 2008-2018	48,437 609 1,568 8,737 3,833 3,151 32,516 11,889	https://www.mumbailive.com/en/civic/nargis-dutt-nagar-fire-48434-people-died-in-last-10-years-in-fire-at-mumbai-29746.
M11	Total calls) Total calls) Total calls)	2019 2018 2017	16,360 15,361 15,704	https://www.mumbailive.com/en/infrastructure/2019-in-review-highest-number-of-fire-incidents-in-three-years-43660.
M12	F (calls) D I F (calls) D I	2022 2022 2022 2021 2021 2021	4,417 13 160 4,065 19 173	https://www.mumbailive.com/en/civic/mumbai's-fire-incidents-sees-7-increase-this-year-82066.
M13	D D D	2021-2022 2019-2020 2020-2021	34 20 18	https://indianexpress.com/article/cities/mumbai/fire-incidents-killed-102-in-5-years-in-mumbai-fire-brigade-8938952/.
M14	F F F F F F D D D D D D I I I I I I I (firefighters) I (firefighters) I (firefighters) I (firefighters) I (firefighters) I (firefighters))	2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018 2012-2013 2013-2014 2014-2015 2015-2016 2016-2017 2017-2018	4,756 4,400 4,842 5,212 5,021 4,927 62 58 32 47 34 55 177 141 125 128 115 219 13 29 31 23 (+5 D) 13 8	https://www.mumbailive.com/en/civic/300-people-suffered-during-the-last-six-years-in-mumbai-fires-rti-report-24537.
M15	Fire stations Fire trucks Ambulances	2020 2020 2020	35 115 15	https://www.mumbailive.com/en/civic/here's-why-the-city-needs-more-fire-stations-bmc-prabhat-s.-rahangdale-45572.
M16	Fire stations	2025	51 (including 17 small stations)	https://www.mumbailive.com/en/civic/seven-new-fire-stations-in-mumbai-centers-at-kandivali-and-kanjurmarg-completed-87666.

No.	Parameter	Year(s)	Number	Remark / Source
M17	Stop fires Level 1 fires Level 2 fires Level 3 fires Level 4 fires Total fires Stop fires Level 1 fires Level 2 fires Level 3 fires Level 4 fires Total fires	2023 2023 2023 2023 2023 2023 2024 2024 2024 2024 2024 2024	4,993 57 14 9 1 5,074 5,228 55 13 4 1 5,301	https://www.securitytoday.in/mumbai-recorded-5301-fire-incidents-in-2024-227-more-than-previous-year/. Note: 'stop' fire calls are blazes which were extinguished either before fire brigade arrived or were doused before declaring Level 1. Level 4 fire – highest level of fires. Stop fires + ∑(Level 1 … Level 4 fires) = Total fires.
M18	Total calls Fire calls D (fire) I (fire)	2024, Jan. 1-Jul. 31 2024, Jan. 1-Jul. 31 2024, Jan. 1-Jul. 31 2024, Jan. 1-Jul. 31	10,566 3,197 8 112	https://timesofindia.indiatimes.com/city/mumbai/mumbai-fire-incidents-8-deaths-112-injuries-in-3197-cases/articleshow/112637154.cms.

Table 5 lists the key statements extracted from media M1-M18 for Mumbai. It is striking that annual values are not always given, but usually, several months were chosen as the reporting period, which does not make it easy to compare the statements. There is also no stringent uniformity in the terms used: fires (F), fire operations - F(calls). Nevertheless, the total number of fire brigade operations in Mumbai can also be filtered out:

- M18: Total calls (means fire and other/special calls) are given for 2024 Jan.-Jul. with 10,500. So, one can assume that the annual value is then 18,000-20,000. The number of annual fires should then logically be correspondingly smaller.
- M11: in this source, the terms "fire calls" and "fire incidents" are mentioned at the same time. However, taking M18 into account, it must be the total number of fire brigade operations: 16,000 (2019), 15,000 (2018), and 15,500 (2017).

For the "fire calls", F (calls), i.e. presumably the real fires plus false alarms for fires, it can be said:

- M1: Fires, F (calls) annual average 4,800 for 2008-2020. In 2020 there were 3,800 fire calls.
- M2: Fires, F (calls) 4,400 (2017), 4,900 (2018), 5,300 (2019), 4,500 (2020), 4,000 (2021, M3/M5), and 4,400 (2022, M3/M5), 5,000 (2023, M5/M8/M9), 5,300 (2024, M8/M9).

The number of real fires is then the following information:

- M14: number of fires (F) are 4,700 (2012-2013), 4,400 (2013-2014), 4,800 (2014-2015), 5,200 (2015-2016), 5,000 (2016-2017), and 4,900 (2017-2018).
- M17 provides an explanation of the composition of the fires according to their extent. In 2023, there were 4,993 "stop fires" plus 57 Level 1 fires, plus 14 Level 2 fires, plus 9 Level 3 fires and 1 Level 4 fire. That is a total of 5,074 fires. In the same way, the statistics then show 5,301 fires for the year 2024.
- M10 provides specific information about the fire objects and the causes of the fire. In 2008-2018, 3.2% of fires occurred in high-rise buildings. This is followed by 18% of fires in residential buildings, 7.9% in commercial buildings, 6.5% in slum areas, and 64.3% in other fire objects (many of which are probably outdoor and waste fires). With regard to the causes of the fire, the following picture emerges. 67.1% of all fires are due to short circuits in electrical wiring or

equipment. This is followed by 24.5% of all fires due to technical defects or handling of gas cylinders. The remaining 8.3% is attributable to other causes.

The analysis of the press releases for Delhi and Mumbai shows an annual number of real fires of over 20,000. This value exceeds the number of cases in the NCRB reports for India (around 10,000 fires). Thus, it should be proven that the NCRB reports only consider the cases in which deaths were to be mourned. From the media information, it can be seen that in Mumbai, for example, 98% of all fires are so-called "stop the fire," i.e., fires that were extinguished before the fire brigade arrived or were doused before declaring to a higher level. In all likelihood, hardly any fire victims were mourned in these fires. That would correspond to the international fire statistics.

Table 6: Fires and fire deaths according the statistics on selected units.

State / UT/ City	Population, in 1,000,000	Fires				Fire Deaths			
		2020	2021	2022	2023	2020	2021	2022	2023
Andhra Pradesh	49.6	11,446	11,033	10,693	n.a.	36	40	81	n.a.
Delhi NCR	58.2	15,158	14,999	16,518	15,610	102	56	82	59
Himachal Pradesh	6,9	n.a.	2,604	4,411	2,213	56	34	n.a.	n.a.
Mizoram	1.6	168	275	n.a.	n.a.	1	0	15	4
Mumbai	18.4	4,512	4,065	4,417	5,074	33	19	13	33
Nagaland	2.2	111	192	103	217	1	1	0	3
Tamil Nadu	76.9	19,142	16,809	19,206	25,469	26	82	67	130
Telangana	37.7	n.a.	6,789	7,368	n.a.	124	n.a.	45	n.a.
Uttarakhand	12.2	1,572	2,248	1,829	n.a.	27	n.a.	n.a.	n.a.
Subtotal	263.7	52,109	59,014	64,545	48,583	406	257	303	229
R_1 (Fires per 1,000 Inh.)		0.23	0.26	0.29	0.21	-			
R_2 (Deaths per 100 fires)		-				0.78	0.44	0.47	0.47
R_3 (Deaths per 100,000 Inh.)		-				0.18	0.11	0.13	0.10

Now, let's look at Table 6. Eight states of different sizes or UT (Dehli NCR) and one city (Mumbai) are shown with the number of fires and the number of victims for the years 2020-2023. The selection corresponds to the availability of statistics of the respective fire brigades (see Table 1). Some figures are not available (n.a.)

The following picture emerges for the sample. Around 264 million people live in the listed administrative units. The fire brigades register between 48,000 and 66,000 fires annually (small, medium, and large, or "stop fires" plus level 1 to 4 fires). The number of deaths in fires is between 220 and 400.

With this information, it is possible to calculate the primary fire risks for the selected units:

- **R_1** (risk to be affected fire [F/1,000 Ihn.]) is in the interval 0.21-0.29).
- **R_2** (risk of a person losing his life in a fire, i.e., becoming a victim. The unit of measure [victims / 100 fires a year]) is in interval 0.44-0.78).
- **R_3** (the risk for a person to die due to a fire per unit of time [victims / 100,000 inhabitants and year] is in interval 0.10-0.18.

The entire history of fire risks and the risk model developed by the CTIF can be found in the source (please ask for a copy). [10]

[10] Brushlinsky N., Sokolov S., Wagner P.: Humanity and Fires, EDURA, 2010, pp. 353, ISBN 978-83-88777-29-5.

We then assume that the data from Table 6 come from trusted sources and that the identified fire risks can serve as a basis for estimating the fire situation in India.

Table 7: Estimation of primary fire risks in India:

No.	Variant	Inhabitants, in 1,000	Fires	Deaths	R_1 Fires, per 1,000 inh.	R_3 Deaths per 100,000 inh.	R_2 Deaths per 100 fires
	A	B	C	D	E	F	G
1	V1a	1,383,000	***11,037***	10,915	0.01	0.79	98.89
2	V1b	1,396,000	***9,329***	9,190	0.01	0.66	98.51
3	V2a	1,426,000	300,000	10,915	0.21	0.77	3.64
4	V2b	1,426,000	300,000	9,190	0.21	0.64	3.06
5	V3a	1,426,000	370,000	10,915	0.26	0.77	2.95
6	V3b	1,426,000	370,000	9,190	0.26	0.64	2.48
7	V4a	1,426,000	410,000	10,915	0.29	0.77	2.66
8	V4b	1,426,000	410,000	9,190	0.29	0.64	2.24
9	V5a	1,426,000	***1,600,000***	20,000	1.12	1.40	1.25
10	V5b	1,426,000	***1,600,000***	27,000	1.12	1.89	1.69

Table 7 presents the estimation of primary fire risk in India. We have created 10 scenarios (V1a, ..., V5b). The columns "A" to "G" reflect the parameters of the estimates. In lines "1" to "10," various thought models are summarized as variants.

In Scenario "V1a" and "V1b," India's population figures for 2019 and 2020 are shown in column B (source: Indian Census data). The NCRB reports provide the number of fires (column C) and the number of deaths (column D). Since the number of fires here is practically identical to the number of victims, the values of the fire risks in columns "E," "F," and "G" are corresponding. Both scenarios are borderline and at the lowest level imaginable. We remind the reader of the discussion on this in the sections described above.

Now, look at the scenario "V2a" to "V4b". The population figure (column B) stands for 2023. From Table 6, we have transferred risk R_1 to column E. The number of victims remained unchanged (column D). Then, the number of fires in India in scenarios "V2a" and "V2b" must be around 300,000 to achieve the risk R_1=0.21 (see Table 6). In rows 3 and 4, the risks R_2 and R_3 differ because of the number of deaths from column D. Then on to scenarios V3a and V3b. If the risk is R_1=0.26, i.e., higher than previously assumed in scenarios V2a and V2b, then the number of fires in India should be around 370,000. Finally, in scenarios "V4a" and "V4b", we assume that R_1=0.29. In this case, the number of fires in India is about 410,000.

The scenarios "V5a" and "V5b" reflect the figures given in the BMJ source.

What can we conclude?

In scenario 1, the risk values are too low, and in scenario 5, they are probably much too high. In scenarios 2 to 4, we have reflected our ideas using the CTIF risk model.

A more or less complete fire statistic for all states of India is required to document the real fire risks.

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The Report #30, Fire Statistics Magazine 2025, for the reporting year 2023, is available; head here! In Report 30 the Center of Fire Statistics (CFS) features a special chapter: "Towers on Fire - Fires in High-Rise Buildings", read here …

Since 1995, the Center for Fire Statistics (CFS) has published figures on the fire situation in states and large cities:
Year 1995 – 17 countries;
2000 – 54 countries/30 cities;
2004 - 85 countries/90 cities;
2005 - 85 countries/90 cities, and Report 30 (2025) read here about most recent statistical fire data …

Moreover, the Center for Fire Statistics (CFS) supports the work of other CTIF commissions; for example, the History Commission (writing articles). In recent years, international students who contact the CFS with questions about their bachelor's or master's theses have also been supported. Wherever appropriate, CFS team members engaged in international conferences to promote CTIF's mission. For two years now, the CFS team has been taking care of the **donation of fire safety literature** for the **CTIF library** in **Pribyslav** (Czech Republic).