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Multi-Storey Houses, the Fire to Ensure Safety

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Abstract: This study examines fire safety challenges in multi storey residential buildings, focusing on the increasing use of imported and locally produced construction materials. Fires frequently occur due to the thermal degradation of materials, producing toxic gases that pose serious risks to human life and property. Despite existing regulations, current fire safety systems remain insufficient for effective prevention and response.

The research identifies key gaps, including limited use of modern technologies, weak predictive capabilities, and low automation in fire detection and rescue coordination. Additional risks arise from improper material use, poor ventilation systems, and inadequate safety compliance.

Using qualitative and regulatory analysis, the study evaluates construction practices, fire safety standards, and risk factors related to materials and building systems.

Findings show that most fire incidents are linked to material properties and system failures. The study concludes that improved regulations, advanced fire detection technologies, and stronger safety awareness are essential to reducing fire risks and enhancing building safety.

Keywords: Fire safety, risk assessment, enterprises, buildings, measures, automatic fire alarm.

Introduction

The production of building materials is inherently associated with high temperature processes and therefore involves increased fire and explosion risks. The manufacturing of materials such as cement, bricks, and other heat treated products requires careful monitoring and critical assessment of technological processes to ensure safety and prevent hazardous incidents [1].

Within enterprises, specific fire safety regulations and operational instructions must be clearly established. Engineering and technical personnel are assigned responsibility for compliance within defined timeframes, and fire safety supervision systems should be implemented. In addition, employees must undergo regular training and instruction to ensure awareness and adherence to fire safety requirements.

Fires in multi storey buildings can lead to severe and often catastrophic consequences. These risks are intensified by the use of flammable construction and finishing materials, malfunction or improper installation of automatic fire detection and suppression systems, and the rapid vertical spread of smoke and fire through stairwells, ceilings, and ventilation shafts. Structural openings and design flaws further complicate effective firefighting operations.

Although general principles of firefighting and rescue operations are defined in national regulatory documents, existing approaches do not allow for accurate prediction of fire

development in multi storey buildings. Furthermore, the limited use of modern information technologies and low levels of automation reduce the efficiency and speed of fire response systems [2][3].

The storage and use of explosive, flammable, and fire hazardous substances within residential apartments are strictly prohibited. Additionally, altering the functional purpose of residential spaces without proper authorization and compliance with building regulations is not permitted.

Methodology

The methodology of this study is based on a qualitative analytical approach focused on evaluating fire safety conditions in multi storey residential buildings. The research relies on a comprehensive review of national regulatory documents, building codes, and fire safety standards, along with analysis of existing literature and documented fire incidents related to construction materials and building systems . Particular attention is given to the characteristics of imported and locally produced construction materials, especially their behavior under high temperature conditions and their potential to release toxic combustion products [4].

The study incorporates a comparative assessment of fire risk factors, including material flammability, ventilation system design, and the presence or absence of automatic fire detection and suppression systems. Observational analysis is used to examine typical structural layouts of multi storey buildings, identifying pathways for fire and smoke spread such as stairwells, ventilation shafts, and ceiling openings. In addition, regulatory compliance is evaluated by comparing actual building practices with established safety requirements related to storage of flammable substances, gas equipment usage, and reconstruction procedures [5].

The methodology also considers human and organizational factors, including safety awareness, maintenance practices, and emergency preparedness. By integrating regulatory analysis, risk assessment, and case-based observations, the study provides a systematic evaluation of current fire safety challenges and identifies critical areas requiring improvement.

Result and Discussion

In individual residential buildings and apartments, it is permitted to store flammable liquids in living spaces only in closed containers, with a maximum volume not exceeding 10 liters. However, highly flammable liquids in quantities exceeding 3 liters must be stored in appropriate, non fragile containers designed to prevent leakage and ignition [6]. The storage of flammable liquids, gas cylinders, and spare gas containers inside residential premises is strictly prohibited.

Household gas appliances, including stoves, water heaters, and similar equipment, must be supplied with gas cylinders that are typically installed outside the building. These cylinders should be placed in specially designed enclosures, such as protective cabinets or compartments, which are covered and secured. The placement of gas cylinders must ensure a safe distance from building openings, basement areas, and structural elements, generally not less than 5 meters from potential ignition sources.

Gas cylinder enclosures must be properly ventilated and securely locked, with ventilation openings fitted with grilles. Additionally, clear warning signs such as “Flammable Gas” must be visibly displayed to indicate potential hazards and ensure safety compliance [7].

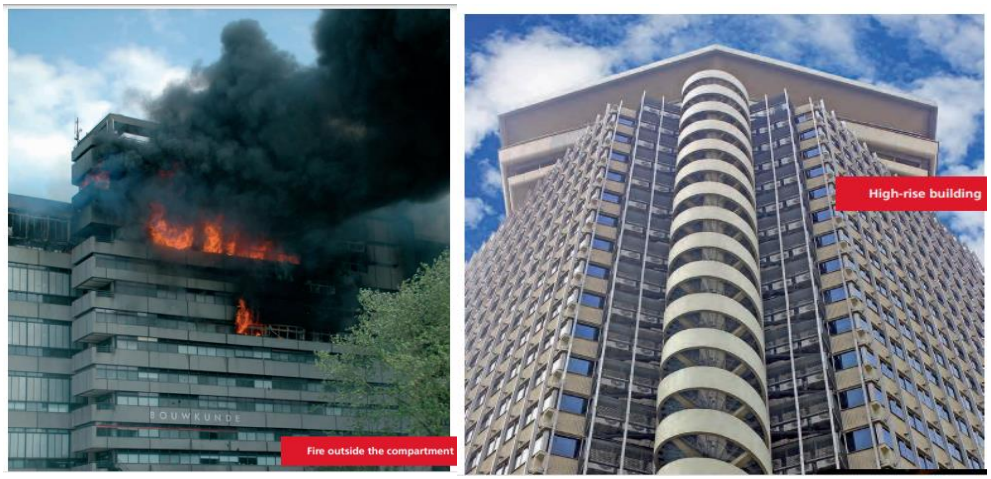

Figure 1. View of fire in compartment from outside and image of high rise building.

The installation and operation of two or more gas cylinder devices, as well as their use within residential buildings, must be carried out strictly in accordance with current regulatory requirements established by the gas safety authorities. Proper placement and safe operation are essential to prevent accidents and ensure the safety of occupants.

In individual residential buildings, including cottages, where bottled gas is used, clearly visible fire safety warning signs such as “Flammable Gas Cylinder” must be installed at the entrance to the building and in relevant areas [8].

During the use of gas equipment, the following actions are strictly prohibited: operating devices with gas leaks; connecting gas fittings using tools that may produce sparks; and checking for leaks using open flames such as matches, lighters, or candles.

Reconstruction or modification of apartments may only be carried out by licensed organizations or individuals based on approved project documentation. Changes that do not alter the functional purpose of the premises must be approved by regional authorities, while functional changes require specialized expert review.

The unauthorized conversion of residential buildings into non residential use, as well as structural modifications that compromise load bearing capacity or fire safety requirements, is strictly prohibited [9].

All reconstruction and new construction projects must comply with current building codes and regulations, including officially approved design standards, and must adhere to applicable legislation governing the technical operation of housing facilities.

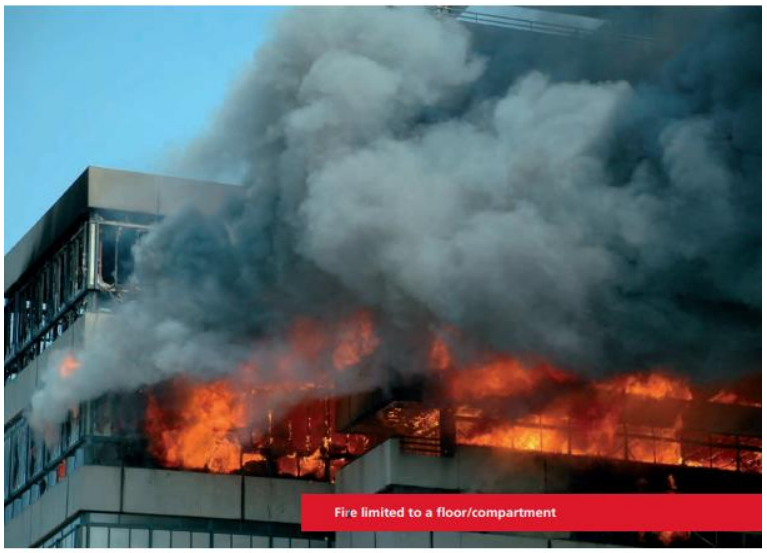

Figure 2. In multi-storey buildings to happen the risk of fire.

Reconstruction and repair of apartments in residential buildings may be carried out by owners, tenants, or authorized users based on legal agreements, provided that the work complies with property rights and approved regulations. Structural elements such as balconies and loggias that serve as secondary emergency exits must not be enclosed or altered in a way that restricts evacuation [10]. It is recommended that residential buildings, including newly constructed, reconstructed, or renovated apartments, be equipped with autonomous fire detectors to enhance early fire detection and occupant safety.

Fire safety requirements for heating and ventilation systems must be clearly defined through operational guidelines. These guidelines should include fire prevention measures, regular cleaning schedules for air ducts, filters, and fire dampers, as well as procedures for responding to fires, accidents, or system failures. Maintenance personnel must conduct regular inspections and promptly eliminate any defects that could contribute to fire spread [11]. Only trained and certified individuals are permitted to operate ventilation systems. Storage of materials in ventilation chambers or shafts is strictly prohibited, and all access doors must remain closed and secured.

All fire protection devices, including valves, dampers, and automatic shut off systems, must be regularly inspected to ensure proper operation, especially during fire emergencies.

The use of solid fuel heating appliances above ground level (excluding basements) is permitted only under regulated conditions. Ventilation systems connected to heating devices must be properly designed, ensuring safe discharge through dedicated channels such as kitchens or ventilated spaces [12].

Combustible and slowly combustible building structures must be properly separated from chimneys and flue systems through fire resistant insulation. Chimneys must be regularly inspected, free of cracks, and cleaned at least once every three months during the heating season to ensure safe operation.

The following is prohibited in the use of heating and ventilation systems:

Wrong turn on or off the control and regulation device to work with. also, in the absence of them;

Disable or remove devices fire;

Leave the doors open for ventilation of the camera;

Camera store any materials in the ventilation;

The ventilation channel, and close the holes of the grate;

Use the general lighting in residential buildings and dust should be cleaned at least 2 times per year to pass from periodic checkings

Fire resistant structural design has traditionally focused on ensuring the stability of a building during fire exposure [13]. This approach aims to prevent structural collapse and reduce the risk of injury or loss of life, particularly for occupants who may not be aware of the fire hazard. While this method is generally effective, it may be insufficient when applied to different building types, such as single storey or small residential structures, where broader safety considerations and occupant protection must also be taken into account.

With the introduction of modern fire safety codes, there has been an increasing emphasis on performance based design and a clearer understanding of design objectives. These codes require not only structural stability but also consideration of evacuation safety, fire spread, and overall risk management. Studies, including those conducted by Stromgren, indicate that there is significant variation among practitioners in interpreting fire safety design objectives, particularly in the context of steel structures and low rise buildings [14][15]. This highlights the need for more consistent guidelines and a unified approach to fire safety design in order to improve effectiveness and reliability.

Conclusion

Approach fire from the effects of family structure you can survive the heat in a place where the need for the prevention of injuries, however if you can survive the effects of heat, may be the way to put the fire the family research council. Fire safety requirements apply also other constructive approach to work-based design in the context of the basic requirements for all buildings works.

References

[1] M. D. Brown and A. S. Lowe, *Reference Manual to Mitigate Potential Terrorist Attacks Against Buildings*. FEMA, 2003.

[2] National Emergency Management Agency, “Fire in Daegu Subway,” *Disaster Reports*, 2004.

[3] T. Schultz, “Danmark stod i flammer i nat,” *Ekstra Bladet*, Feb. 15, 2008.

[4] “2005 civil unrest in France,” *Wikipedia*, 2011.

[5] R. V. Handley, P. M. Salkovskis, P. Scragg, and A. Ehlers, “Clinically significant avoidance of public transport following the London bombings,” *Journal of Anxiety Disorders*, vol. 23, no. 8, pp. 1170–1176, 2009.

[6] R. Pangi, “Consequence management in the 1995 Sarin attacks on the Japanese subway system,” *Studies in Conflict and Terrorism*, vol. 25, no. 6, pp. 421–448, 2002.

[7] L. G. Klason, P. Andersson, N. Johansson, and P. van Hees, “Design fires for fire protection engineering of Swedish school buildings,” in *Proc. 12th Int. Conf. on Fire and Materials*, London, 2011, pp. 159–170.

[8] P. van Hees, G. Holmstedt, S. Bengtson, B. Hägglund, T. Dittmer, P. Blomqvist, and A. Lönnermark, “Determination of uncertainty of different CFD codes by means of comparison with experimental fire scenarios,” in *Proc. 11th Int. Conf. on Fire and Materials*, London, 2009, pp. 403–411.

[9] H. Frantzich, “Risk analysis and fire safety engineering,” *Fire Safety Journal*, vol. 31, no. 4, pp. 313–329, 1998.

[10] D. Drysdale, *An Introduction to Fire Dynamics*, 3rd ed. Chichester: Wiley, 2011.

[11] Society of Fire Protection Engineers, *SFPE Handbook of Fire Protection Engineering*, 5th ed. New York: Springer, 2016.
[12] A. H. Buchanan, *Structural Design for Fire Safety*, 2nd ed. Chichester: Wiley, 2017.
[13] M. J. Hurley et al., *SFPE Handbook of Fire Protection Engineering*, 4th ed. New York: Springer, 2008.
[14] International Organization for Standardization, *ISO 834-1: Fire Resistance Tests for Building Construction*. Geneva, 1999.
[15] National Fire Protection Association, *NFPA 101: Life Safety Code*. Quincy, MA, 2021.