



# A Critical Review of Risk Factors and Reliability Assessment Issues of Fire and Life Safety in Buildings

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## ABSTRACT

This paper consist of safety factors particularly in fire, current fire protection measures in buildings do not account for all contemporary fire hazard issues, which has made fire safety a growing concern. So in this study To overcome fire hazards in buildings, impact of fire hazards is also reviewed to set the context for fire protection measures. Based on the review, an integrated framework for mitigation of fire hazards is proposed.

Keywords: fire hazard, safety factors, buildings

## 1.Aim

To review the various past studies on safety due to fire and give conclusions based on past studies and future scope in small towns for residential buildings.

## 2. LITERATURE REVIEW

**Musab umar, 2023**, identifies the critical factors affecting fire accidents in high-rise residential buildings in the Emirate of Sharjah in order to find solutions that contribute to reducing injuries and deaths from fire accidents. A large urban expansion of the Emirate of Sharjah has taken place in the form of high-rise buildings, and the Emirate is now third in the UAE in terms of the number of high-rise buildings and is home to 19% of the population. As a consequence, an increase in the rate of fire accidents has also been observed. the fire characteristic is unique in every country, to identify the nature of fire in the Emirate of Sharjah, he consulted sixteen subject matter experts in the field of fire in the Emirate of Sharjah to identify the factors applicable to the Emirate. The outcome of the consultations resulted in the three main factor categories, which are management factors ,human factors, and technical factors, and the critical factors affecting the high-rise buildings in the Emirate of Sharjah were identified, which are: fire regulations, fire enforcement regulations, accident investigation, rescue speed, human behaviour, lack of proper maintenance, fire training, building design, fire knowledge, combustible materials, fire culture of society, and urbanization.

**Kuldeep Kumar Virendra Kumar Paul** identified the complexity of fire hazards, and Vulnerability factors have increased manifolds, resulting in substantial loss of lives and Property. In a typical practice of fire safety, the focus tends to be on compliance with the Minimum statutory requirements such as the provision of fire protection measures, Provision of egress, compartmentation, and smoke control. Despite statutory Compliances and proactive initiatives, there is an issue of reliability that would vary Depending upon the extent of responsibility owned by the beyond codes and best Practices. This paper aims to identify and assess the risks that pertain to the reliability of Life and fire safety measures undertaken in a given context so that the performance Reliability can be established for monitoring and improvement during various stages of The building life cycle. This should lead to the development of fire risk and reliability Assessment protocol considering determinants such as building occupants, current and Future functioning of the building, building facilities management system, and Obsolescence status of building engineering systems, including those related to life and Fire safety. This paper focuses on the identification of fire risk factors and establishing The reliability issues in the buildings.

**Pejman Rezakhani(2012)** found that the risk modeling and analysis is one of the most important stages in a project's Success. There are many approaches for risk assessment, and an investigation of existing methods helps in developing new models. Reference is an extensive literature survey in risk modeling and analytic methods with a main focus on fuzzy Risk assessment. [18]

**Chitra sen Samantra , Saurav Datta (2017)** state the concept of risk matrix has been Explored herein to categorize various risk factors at different levels of severity for the establishment of necessary actions Requirement plan. A case study of a metropolitan construction project for building an underground metro rail station has been Reported here to demonstrate application procedural steps of the proposed methodology. [5]

**Patel Kishan (2017)** found that construction projects are initiated in complex and dynamic environments resulting in Circumstances of high uncertainty and risk, which are compounded by demanding time constraints. For that each construction Project itself is a complex system. Risks always exist in

construction projects and often cause schedule delay or cost overrun. This study involved finding of 47 factors which are responsible for risk in construction projects. [17]

**Miss. Amita Pawar and Prof. Snehal Pagey (2017)** identified gaps and inconsistencies in the knowledge and treatment Of construction and project risk. The paper describes, on the basis of a questionnaire survey of general contractors and project Management practices. author conclude that risk management is essential to construction activities in minimizing losses and Enhancing profitability. Construction risk is generally perceived as events that influence project objectives of cost, time and Quality. [13]

**Dr. A. S. N. Chakravarthy , Mr. T. Anjikumar (2014)** proposes a new fire safety system to prevent the fire accidents in rural areas in the initial stage only using wireless sensor networks. The fire spreads very quickly throughout the village and causes great damage before the fire fighters arrive to the fire affected area. A new fire safety system is proposed to prevent fire accidents in villages using wireless sensor networks. By implementing this fire safety system in villages, one can detect the fire accidents and can bring the fire under control in the initial stage only without the involvement of the fire fighters which reduces the cost of rescue operations. By using the Wireless Sensor Networks, one will be able to know when a fire is started and how it is spreading. This fire safety system can be used not only in rural areas but also in various places such as buses, trains, forests, and tribal areas with small modifications in the system. (3)

**Woon Chin Ong, MohdZailanSuleiman(2015)** There were many fire accidents in the hospital building identify the mistakes and problems which happened on the fire scenes and will try to prevent the repeat of similar mistakes and problems. In the other words, these lessons can be references to establish good fire safety management in hospital building focuses on 13 significant historical fire accidents in hospital buildings through reviewing the journals, investigation papers, news and others. These cases occurred all over the world from 1918 through 2013. This study found out that the lessons of fire accidents should include installment of automatic fire systems, maintenance of fire systems, having old hospitals comply with existing laws, escape route plans, staff training and management during and after fire accidents. Fire safety management including these elements is strongly recommended for implementation in the hospital building. (4)

**Jonathan Wahlqvist, Patrick van Hees (2016)** Focused on investigating several key characteristics of a building (building material, openings, room floor area size and ceiling height) and its effect on the design fire using computational fluid dynamics. When well to moderately insulating materials was used the design fire growth rate and maximum heat release rate was in many cases significantly increased, especially if the room was well ventilated, the ceiling height was relatively low and the room floor area was moderate. However, using thermally thin materials (steel sheet) or materials with large heat storing capacity (concrete) very little change was seen on the growth rate or maximum heat release rate. In conclusion it was recommended that one should take precaution when using recommended design fires in buildings with certain characteristics since it potentially can overestimate the safety in such case. (6)

**Rosaria Ono (2015)** presents the results of a study of high-rise building fires through the analysis of the São Paulo State Fire Department database as well as the results of a field survey in high-rise office buildings, focusing the matter of the occupant's fire safety consciousness. Despite the concern of some public authorities on fire safety improvement, it is very clear that the general population and particularly those who live or work in high-rise buildings are neither aware of fire prevention measures nor prepared to face fire incidents. These matters are also discussed and analyzed in an evaluation of the level of implementation of existing fire regulations in high-rise buildings is intended, together with the evaluation of fire safety consciousness of the population through the analysis of fire incident reports and a field survey in existing buildings.(7)

**Jian Jian, et.al. (2015)** presents an independent review of the performance of Shanghai Tower in case of fire. Two fire scenarios: standard fires and parametric fires have been considered. The fire resistance of key component, including the concrete core, mega columns, the composite floor, outrigger trusses and belt trusses were examined first. Their real fire resistance periods proved to be far beyond the design fire resistance. The components with weak fire resistance such as peripheral steel columns and web members of belt trusses were then removed to study the resistance of the residual structure against progressive collapse. The results show that Shanghai Tower has a minimum of 3 h fire resistance against fire-induced progressive collapse. The concrete components have smaller residual displacements compared to the steel components. (10)

**MainaKironji (2015)** examine the situation of physical (as opposed to non-physical) fire protection systems in fourteen randomly selected commercial highrise buildings in the Nairobi CBD for fire safety optimization. Methods used include; physical observations, document review and interviews. A multi-attribute evaluation model/approach was applied to establish sufficiency and/or suitability of fire protection systems in the light of the national regulations and approved standards. The study findings show that, save for the facilities of the disabled and the firefighting/evacuation lifts, other fire protection systems are mainly provided in the buildings. However, insufficient maintenance and/or unsuitable elements render their safety performance low. (11)

**Adam Cowlard, et.al. (2013)** highlight the critical elements of a fire safety strategy for tall buildings and thus attempt to highlight some specific global performance objectives. A survey of tall building fire investigations is conducted in order to assess the effectiveness of current designs in meeting these objectives, and the current state-of-the-art of fire safety design guidance for tall structures is also analysed on these terms. The correct definition of the design fire for open plan compartments is identified as the critical knowledge gap that must be addressed in order to achieve tall building performance objectives and to provide truly innovative, robust fire safety for these unique structures. This work endeavours to provide an assessment of the state-of-the-art of fire safety engineering for tall buildings. It seeks to define the specific performance objectives to enable a successful tall building fire safety strategy, and assesses failure statistics which provide an indication of our current ability to successfully engineer the principle issues identified.(13)

**Mrs. Lilly grace murali 2014** Fire accident in buildings is a threatening one now a day. These accidents create heavy lives and property losses. To find the reasons, frequency and giving protection to all type of buildings became challenges to the professionals. In this paper four case studies are presented, the reason for fire or ignition source, fire spread, reasons for lives losses, property losses, position of passive, active measures are analyzed; few spot photos are also incorporated. Solutions are given for each case study buildings, the common needed solutions also given to avoid the accidents in future

#### 4. Risk Assessment For Residential Structure At Jalgoan Maharashtra

### 3. RISK AND RELIABILITY ASSESSMENT FACTORS

Sr . No	Risk factors	RII
1	Exhaust system	0.88
2	Natural ventilation	0.65
3	Smoke barriers	0.56
4	Dampers	0.76
5	Pressurisation	0.75
6	Stack effect	0.60
7	Duct insulation	0.68
8	Smoke reservoir	0.63
9	Wind effect	0.65
10	Compartment components	0.70

#### 4. Future Scope:

The established reliability issues associated with the risk factors pertaining to fire and life safety can be useful for further development of a fire risk vulnerability index to ensure the overall reliability of the fire safety systems.

#### 5. Conclusions:

The fire safety systems right from the design stage, wherein proper considerations and mitigation measures can be employed to ensure the intended performance of the fire safety and protection systems in its operational phase are established. It also aims to engage, inform and sensitize all stakeholders about the emerging fire risks for the building projects, so that appropriate and ingenious steps and decisions can be taken right in the design or preconstruction stage only.

The fire safety systems are usually well designed and properly installed in the building, however, the problem appears after this stage, where it is frequent to observe a complete disregarding for accomplishment of maintenance and test planning. Furthermore, during the operational phase of the building, it is not reasonable to assume that the reliability of the fire protection system/equipment remains persistent and its deterioration due to aging over a period of time needs to be considered to derive a more realistic and effective assessment. Generally, the fire protection systems in the building remain inactive or dormant for long periods leading and can only be noticed or detected through regular tests/inspections . Such issues can be addressed through efficient risk analysis and reliability assessment including suitable mitigation measures, audits, establishing maintenance and test planning and assuring its accomplishment.

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