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## Fire Risk in the Built Environment: Towards Sustainable Urban Resilience in Colombo City Area

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### Abstract

Ensuring fire safety in commercial buildings is a vital yet frequently neglected component of sustainable urban development in the Colombo City area. Rapid urbanization and the increasing prevalence of high-rise, multi-occupancy buildings have intensified fire-related risks, particularly in densely built environments such as the Colombo City area. Despite the existence of national regulations, widespread non-compliance and inadequate enforcement have heightened vulnerabilities, threatening lives, property, and urban resilience. Fire incidents disrupt economic activities, increase disaster exposure, and undermine sustainable land-use and environmental planning. This study evaluates the fire risk levels of ten representative commercial buildings in Colombo using a semi-quantitative, checklist-based fire risk assessment tool specifically developed for the Sri Lankan context. Unlike conventional assessments that primarily focus on structural or technical provisions, the proposed tool adopts an integrated approach encompassing passive and active fire protection systems as well as fire safety management practices throughout the building life cycle. The tool, validated across over 50 prior facilities and published studies, was systematically applied to ten purposively selected commercial buildings in the Colombo City area, differing in age, height, and construction type. Based on data gathered through field inspections and interviews, fire risk was assessed using the newly developed tool, which applies the Relative Importance Index (RII) method and a four-tier scoring system across five key domains: means of escape, structural fire protection, detection systems, suppression systems, and fire safety management. Findings reveal alarming deficiencies in compliance. Active fire protection systems showed less than 35% compliance, while fire safety management practices fell 59% below required standards. Overall, commercial buildings achieved only 43% compliance with local Construction Industry Development Authority (CIDA) fire regulations and 44% alignment with British Standards and best practices. None of the evaluated buildings met the “low risk” classification; 50% were categorized as high risk and 40% as moderate risk, with older structures performing significantly worse. The results highlight an urgent need to transition from prescriptive regulatory frameworks toward integrated fire risk management approaches that combine engineering design, maintenance, and administrative control measures. Weak enforcement, fragmented legislation, and limited technical capacity remain major challenges. Strengthening regulatory frameworks, implementing systematic compliance monitoring, and promoting investment in modern fire protection systems are essential to safeguard lives and enhance urban resilience. The study contributes a locally adaptable, resource-efficient assessment tool that embeds fire safety within sustainable urban design and climate-resilient development strategies.

**Keywords:** *Fire risk assessment, Built environment, Fire safety management, Sustainable infrastructure, Sri Lanka.*