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RESEARCH FOR THE NFPA MISSION

Guidance for Smoke Detector Spacing on High Ceiling Spaces – Phase II

Background

[NFPA 72, National Fire Alarm and Signaling Code](#), does not address spacing consideration for smoke detection based on ceiling heights. However, there is a table that allows for reduction of spacing for heat detection. There has been confusion in design and code enforcement on what to do when smoke detectors are installed on ceilings higher than 10 ft (3m). A previous literature review and gap analysis [study](#) on smoke detectors in high ceiling spaces was published by the Research Foundation in 2017. The outcomes of this study indicated that there was limited context and significant knowledge gaps that preclude the formulation of scientifically justified prescriptive requirements regarding smoke detector spacing relative to ceiling height. The 2017 study outlined a path forward to better characterize smoke detector spacing in high ceilings, such as by establishing a performance metric for smoke detectors that can be applied to high ceilings.

Since the fire protection industry needed additional information on the impact of ceiling height and detector spacing on smoke detection performance, a Phase II study was initiated.

Research Goal

This Phase II study aimed to develop guidance for the installation of smoke detectors on ceilings over 10 ft (3 m) that can be used as the technical basis for consideration of changes to applicable codes and standards.

LEARN MORE: Download the final report [here](#).

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Summary Observations

The scope of this project comprised of six tasks: Task 1, 2, and 3 comprised of a literature review, development of a taxonomy and gap analysis. Task 4 consisted of model verification and validation. Task 5 and 6 comprised of modeling and development of recommendations.

The project outcomes recommends providing prescriptive guidance up to 40 ft (12 m) ceiling heights, and to encourage performance-based designs for ceiling heights exceeding 40 ft (12 m). For ceilings between 10 ft (3m) and 40 ft (12 m), equations to determine appropriate spacing based on the ceiling height has been proposed for spot type and beam type detectors.

The study recommends the following equation for spot type smoke detector spacing in ceilings higher than 10 ft (3 m) up to and including 40 ft (12 m):

$$x = \frac{70 - y}{2}$$

Where, x = spot detector spacing (ft) | y = ceiling height (ft)

This equation allows a spacing of 30 ft (9.14 m) for 10 ft (3 m) ceiling height.

The beam detector spacing is recommended to be reduced for ceiling height above 20 ft (6 m) up to 40 ft (12 m) using the following equation:

$$x = \frac{50 - y}{0.5}$$

Where, x = beam spacing (ft) | y = ceiling height (ft)

This would allow 60 ft (18 m) beam spacing for ceiling height up to 20 ft (6 m).

For ceiling heights more than 40 ft (12 m), performance-based design is recommended for both spot type and projected beam detectors.