

## Design and Analysis of a Lightweight Fire-Resistant Door

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**Abstract :** This study investigates how lightweight a fire resistance door will perform with under types of insulation materials. Data is initially collected from various websites, scientific books and research papers. Results show that different layers of insulation in a single door can perform better than one insulator. Furthermore, insulation materials that are lightweight, high strength and low thermal conductivity are the most preferred for fire-rated doors. Whereas heavy weight, low strength, and high thermal conductivity are least preferred for fire-resistance doors. Fire-rated doors specifications, theoretical test methodology, structural analysis, and comparison between five different models with diverse layers insulations are presented. Five different door models are being investigated with different insulation materials and arrangements. Model 1 contains an air gap between door layers. Model 2 includes phenolic foam, mild steel and polyurethane. Model 3 includes phenolic foam and glass wool. Model 4 includes polyurethane and glass wool. Model 5 includes only rock wool between the door layers. It is noticed that model 5 is the most efficient model and its design is simple compared to other models. For this model, numerical calculations are performed to check its efficiency and the results are compared to data from experiments for validation. Good agreement was noticed.

**Keywords :** fire resistance, insulation, strength, thermal conductivity, lightweight, layers

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