Abstract

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Gap between code requirements and current state of research on safety performance of fiber-reinforced polymer for nonstructural building components.

In the past two decades, fiber-reinforced polymer (FRP) materials have been increasingly used in civil engineering. Compared with its wide applications in the civil infrastructure system, the use of FRP in buildings is rather limited. One reason for this is that, unlike civil infrastructure, buildings have more stringent nonstructural performance requirements, including those for fire rating, smoke and toxicity, flame spread, water resistance, flood resistance, and so forth. Although numerous studies have been conducted on structural performances of FRP structures, limited studies are available on the nonstructural performance. This paper aims to identify the gap between building code requirements and the current state of research on FRP materials. The first section of this paper is devoted to a summary of the research findings on nonstructural performances. Based on codes and other specifications, the second section systematically examines the code requirements according to the FRP’s target applications, such as load bearing members, interior finishes, exterior finishes, roofings, and their corresponding standards. The next section evaluates the research findings from the first section against the requirements from building codes in the second section. Finally, the applicability, limitations, and future work for FRP materials to be used for building applications are provided in the last section. It can be concluded that, strengthwise, FRP can be used for building applications. Fire rating can be met with different insulate schemes, which vary from 0 to 3 h based on different applications. Exposed FRP needs to meet the requirements of smoke, toxicity, and flame spread. Adding fire-retardant fillers, such as alumina trihydrate (ATH), can enhance performances and meet the code requirements. Further studies on water resistance, weathering tests, flood resistance, combustion, and so forth, are needed. Most of the insulation materials are proprietary and expensive, which restricts their wider applications. It is advantageous to develop cost-effective fire protection systems. No study is available on unified modeling and design guidelines for fire rating, smoke, toxicity, and flame spread. There is a need to provide effective design methods to design these items based on their targeted applications, similar to the methods for structural design.