



## Review

# What to look for in the aftermath of an explosion? A review of blast scene damage observables

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## ABSTRACT

A review of existing literature dealing with the behavior of often-used building materials subject to blast loading is presented. Our focus is on the types of structural damage that might be observed at a blast scene, and in particular how this evidence can be used to infer characteristics of the blast (e.g., size and position of the charge). We consider two simple questions: what does damage look like in the wake of a blast for different structural materials (i.e., “what damage is seen?”) and what must the blast pressure have been to cause this damage (i.e., “what does the damage mean?”). This review looks at reinforced concrete, masonry, steel, glass, and timber. We propose the following principle for interpreting observed damage at a blast scene: *if damage is present, a limit state was exceeded*. The results from this review will be of great interest to post-blast investigators that seek to understand the size and position of a blast.

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## 1. Introduction

Unintentional explosions are highly undesired by pretty much everyone. In process industries, steps are frequently taken to minimize the causes and consequences of accidental explosions [1]. In a security context, measures are often put in place to interrupt attack planning and capability development, to deter would-be attackers from following through with their plans, to prevent those that try to attack from achieving tactical success, and dull the impact of a successful attack [2]. In both of these examples, the focus is on what can be done to minimize the risk of harm or loss before an explosion occurs.

When an explosion happens, attention shifts away from prevention to attribution from the point of view of both cause and effect. The forensic engineer seeks to understand whether any resulting harm to persons or property can be attributed to negligence on the part of those responsible for the design, construction, maintenance or operation of the damaged structural system [3,4]. Following a blast incident, the forensic engineer may be called into assess whether any structures or other engineering artifacts that suffered damage performed as originally intended. That is, was everything working or functioning as it should at the time of the blast, or can some of the blame be attributed to factors other than the blast itself? If negligence was not attributed, the findings from a parallel safety investigation may generate guidance for better and safer designs in the future. In general, the forensic engineer focuses on the effects of the blast that occurred, and not specifically on the blast itself.

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