



WHITE PAPER

# WHAT IS RISK AND HOW IS IT PERCEIVED IN SOCIETY TODAY? STRUCTURAL RELIABILITY UNPACKED

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# ABSTRACT

## **What is risk and how is it perceived in society today? Structural reliability unpacked.**

A look at public understanding and communication of risk. The aim is to highlight the subject of risk literacy and to discuss the ever increasing relevance of this to structural engineers. How should engineers better explain risk and how would this benefit society? The presentation by Grant will address Public perception of risk, risk and structural engineers, communication of risk, and structural reliability.

## AUTHOR

Grant Roe is the Managing Director of Costin Roe Consulting, a civil and structural engineering design firm based in Sydney. Grant Roe has a Masters degree in Engineering and Masters degree in Business Administration. Grant joined Costin Structural in 1990, becoming an Associate in 1995, Partner in 1999, Director of the renamed Costin Roe Consulting in 2001, and Managing Director in 2016.

Since joining Costin Roe Consulting, Grant has worked on many significant commercial, industrial and residential projects. He is a specialist in the industrial sector and has worked on large scale industrial projects in Europe, Asia and Australia. Recently, Grant has become closely involved in the rapidly evolving logistics and fulfilment sector and has been instrumental in smoothly implementing the interface requirements between sophisticated automation systems and buildings. Grant has a keen interest in risk and structural reliability, particularly the general perception of risk and expectations at a societal level.



Risk perception is a complex and multifaceted issue, particularly in the realm of structural engineering. While engineers rely on data, probability, and established standards to assess risks, the general public often views risk through a lens shaped by emotion, unfamiliarity, and societal influences. As Peter Sandman highlights in his equation for risk perception, people tend to overestimate unfamiliar risks while downplaying familiar ones, regardless of the actual probability of harm. This paper seeks to explore the public's perception of risk in structural engineering, the role of structural engineers in risk communication, and how targeted reliability standards shape expectations.

## THE PUBLIC PERCEPTION OF RISK

Consider the risk of death from structural failure compared to a car accident. Statistically, the risk of dying in a car accident is about 35,000 times higher than from a structural failure, yet we think nothing of jumping in the car and society has come to accept a relatively high annual road toll as a part of life. Conversely, the fear of structural failure is often amplified due to the infrequent but high-profile nature of incidents, leading to public anxiety. This dichotomy in risk perception—where familiar risks are accepted, and unfamiliar ones cause alarm—is a challenge that engineers must navigate. New innovations in structural engineering, materials, or methods can be particularly prone to public scrutiny, even when these innovations improve safety and sustainability. Education within both the industry and society is key to increasing acceptance and understanding.

## RISK AND STRUCTURAL ENGINEERS

Structural engineering, like many disciplines, grapples with inherent uncertainties.

**Chaos theory:** when the present determines the future, but the approximate present does not approximately determine the future.

This reflects the unpredictability of certain events—like earthquakes or unforeseen design errors—that may affect a structure's lifespan. In other words, shit happens – that's the nature of the world and it always has been. However, structural engineers must design with the expectation that unpredictable factors will come into play, striving to mitigate them through standards like ISO 2394: *"The appropriate degree of reliability shall be judged with due regard to the possible consequences of failure, the associated expense, and the level of efforts and procedures necessary to reduce the risk of failure and damage."*

## STRUCTURAL RELIABILITY

Countries like China and India are increasingly moving towards higher reliability targets in construction as their economies grow and foreign investment pours into their infrastructure. However, the question of who should bear the cost of these higher standards—governments, developers, or insurers—remains unresolved. What is clear is that insurance companies already account for structural failure risks in their premiums, relying on probability models to anticipate failure rates. For example, one in every 10,000 structures is expected to fail during its lifespan, and insurance policies are designed to cover such rare events. This understanding should inform societal expectations, yet the public is often surprised when these failures occur. Causes of expected failure include impacts such as wind, earthquake, and other natural impacts, as well as errors in design, faulty construction methods or materials, etc. For buildings that are critical to society in the aftermath of disasters, society is willing to pay more for greater structural reliability – engineers are victims of their own success, in this sense.

Several high-profile cases of structural failure in Australia have highlighted the importance of realistic expectations and proper risk communication. Mascot Towers, Opal Towers, Eastern Creek warehouses, and Lacrosse apartments in Melbourne's Docklands (affected by flammable cladding) are examples where either design, material flaws, or external impacts

led to structural issues. These cases serve as reminders that while structural engineers work to minimise risks, failures can still occur.

## COMMUNICATION OF RISK

Engineers are uniquely positioned to explain risk to clients and society at large. However, the need for engineers to become more skilled and proactive in communicating risk is gaining traction globally. The gap between public expectations and actual risk needs to be bridged through clearer communication about what targeted reliability means. In Australia, the targeted structural reliability does not imply total reliability. Rather, it is designed to achieve an appropriate balance between safety and economic feasibility.

Structural reliability is not just the responsibility of engineers. Governments set the standards for reliability targets, and insurance companies adjust premiums to account for expected failure rates. For structures critical to society's functioning after a disaster, such as hospitals and emergency services buildings, society is generally willing to invest in higher reliability levels. The rare occurrence of structural failures in Australia demonstrates that the country's targeted reliability is appropriate. Nevertheless, insurance exists as a safety net for when these failures do occur, ensuring financial losses are mitigated.

Structural engineers are increasingly called upon to play a more active role in communicating the nature of risk to their clients and the broader public. The value that society places on human life and safety directly influences a country's structural reliability targets, but it is important to remember that these targets reflect a balance between total reliability and economic practicality. The low incidence of structural failures in countries like Australia shows that these targets are largely effective. However, as societal expectations shift, so too must the way in which engineers articulate risk, helping the public understand that while failures are rare, they are an expected part of any complex system. In this way, engineers can continue to build trust and foster a more informed public perception of risk in structural engineering.

## KEY TAKEAWAYS

- Public perception of risk in structural engineering is influenced by unfamiliarity and emotional responses.
- Chaos theory highlights the inherent uncertainty in predicting structural reliability.
- Global trends in structural reliability targets are evolving, with insurance companies and governments playing key roles.
- Structural engineers must improve communication about risk to align public expectations with reality.
- The rare occurrence of structural failures demonstrates that current reliability standards are generally effective.



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